Metal Finishing

POLISHING AND BUFFING · BARREL FINISHING · CLEANING
PLATING · ANODIZING · RUST PROOFING · LACQUERING & ENAMELING

SEPTEMBER, 1961

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Lowering Release Torque

Science for Electroplaters
Bright Nickel

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Read and pass on—

PLATING POWER BY DC POWER SPECIALISTS

QUALITY

is a big word at RAPID ELECTRIC

Mathematical Design from Scripta Mathematica

From engineering design and development to final production and shipment RAPID maintains strict control over its quality.

Here's how:

1. Maintaining proper design to application by developing a variety of equipment from years of design experience.

2. Producing major components to its rigid specifications such as power transformers, saturable reactors, magnetic amplifiers, meter shunts, and selenium stacks.

3. Skillful engineering is behind skilled production workers whose years of experience is combined with the latest precision shop equipment and test facilities.

Whether your next rectifier is customed to your needs or a standard line model, if it's a RAPID it will be distinctively different. Call your local RAPID distributor (name available upon request.)

RAPID ELECTRIC CO., INC.

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EMULSION CLEANERS 62 & 75

NOW FAST, LOW-COST
DEGREASING AT ROOM TEMPERATURE

Emulsion Cleaners 62 and 75 remove heavy oil films, solid dirt and buffing compounds at room temperature. Only a plain steel tank is required, eliminating costly vapor degreasing equipment.

Emulsion Cleaners 62 and 75 are safe for use on all metals and are ideal for a wide variety of jobs:

- Cleaning steel and other metals before plating, phosphating and blackening.
- Basket or barrel cleaning of parts.
- Cleaning deeply recessed work preceding electrolytic cleaning.
- Removing grease from machines, floors, automobile engines.
- Air filter cleaning.
- Tin-reflow oil removal.
- Emulsion Cleaner 75 also removes buffing compounds.

These two cleaners, available as liquid or liquid concentrate, are fast working and economical. They are particularly effective for use where wet processing follows cleaning, as in blackening, phosphating and plating. Alkali cleaning time is shortened and the life of alkali solutions is lengthened.

For complete information on how Enthone Emulsion Cleaners can save time and money in your shop, write to: Enthone, Inc., 442 Elm Street, New Haven 8, Conn.

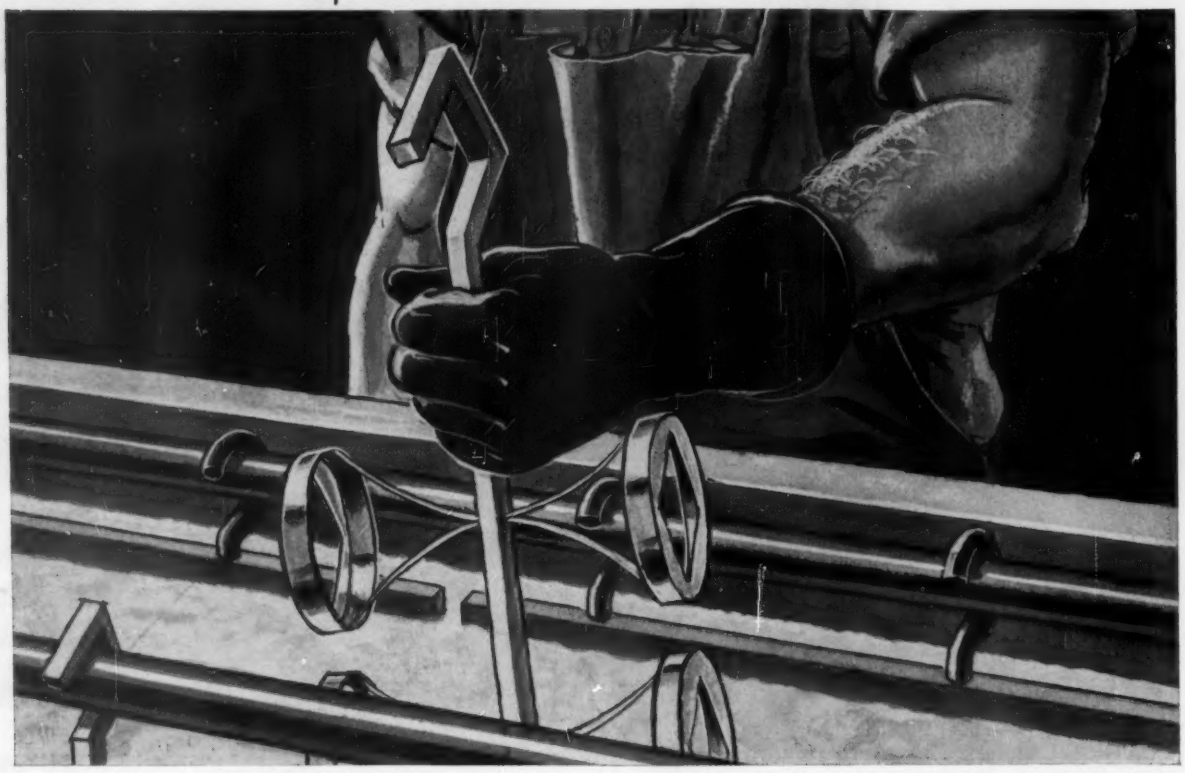
ANOTHER PRODUCT OF *Enthonics* RESEARCH

ENTHONE *A Subsidiary of American Smelting and Refining Company* ASARCO

For the best in reverse-current cleaning

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 FIELD SERVICE MEN • OVER 160 MATERIALS



3 good reasons why Oakite 90 electrocleaner minimizes plating rejects:

High conductivity, superior smut removal and water-softening ability—there's a trio of good reasons why parts come out of Oakite 90 reverse current baths really ready for electroplating, with no soil nor film to cause subsequent rejection.

(1) High conductivity, of course, puts most of the current to work actually cleaning, instead of dissipating power in overcoming resistance. (2) The superior smut removal stems from Oakite 90's excellent wetting, emulsifying and suspending action that *not only* pries soil off but also prevents redeposition. (3) The water-softening action prevents hard-water scums from forming and clinging to parts as they're drawn from the tank.

Add to these... controlled foaming that traps alkaline spray, and exceptionally long solution life... still more reasons why Oakite 90 is the "Number One" choice of platers across the country.

Ask the Oakite man to demonstrate Oakite 90, or write for FREE Bulletin. Oakite Products, Inc., 40 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE®

over 50 *Est. 1909* SCIENCE

years' leadership in industrial cleaning

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For better and more profitable

METAL FINISHING

RELIANCE RECTIFIERS

Standard units or specially designed to meet your individual requirements. Units can be supplied with 4 voltage ranges without current interruption.

63

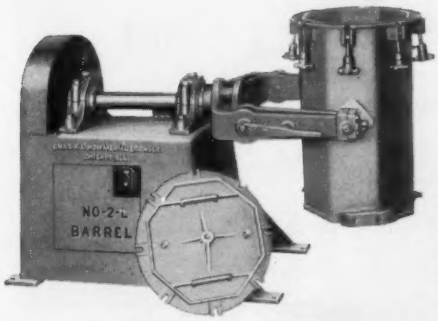
years of experience

manufacturing RELIANCE plating and polishing equipment and supplies

In metal finishing, the equipment you use is sure to govern the degree of quality you get in your finished work. That's why so many plant operators favor L'Hommedieu metal finishing units . . . top notch performers in every respect because they're backed up by 63 years of "know-how" in the building of quality-producing, time-saving machines for the metal finishing industry.

RELIANCE PLATING BARRELS

Designed to save time and labor. Cylinders constructed of warp-free Hard Rubber, Plexiglas or Bakelite. Can be loaded with motor running.

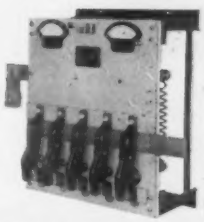


RELIANCE BURNISHING BARRELS

Revolves at a horizontal position or can be set at an angle to give you a flip-flop double tumbling action.

RELIANCE TANK RHEOSTATS

Simple and rugged construction. Self cleaning contact brushes keeps surface clean.



Manufacturers of Metal Finishing Equipment and Supplies

Chas. F. L'Hommedieu & Sons Co.

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Chas. B. Little Co., Newark, N. J. • W. R. Shields Co., Detroit, Mich. • *Branches:* Cleveland-Los Angeles

for faster, more uniform roto cylinder plating

For plating cylinders faster and more uniformly, Anaconda now shapes Plus-4® (phosphorized copper anodes) to fit the rotogravure cylinder being plated.

This design offers possible cost savings and improved cylinder quality. For example, users of these special-shaped anodes report:

- very uniform deposits which help to cut finishing costs.
- more uniform solution of the anode which reduces scrap.

For further information, write for literature describing Curved Plus-4's, and Publication C-5 on Regular Plus-4's. Address: Anaconda American Brass Co., Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

61-939

New Low price anode—Electranodes® are pure Anaconda copper anodes a full 1 inch thick. If you need an "economy type" anode, Electranodes are the best for the least.

ANACONDA®
AMERICAN BRASS COMPANY

STEVCO PROCESSES AND SUPPLIES *mean a brighter future for electroplating*

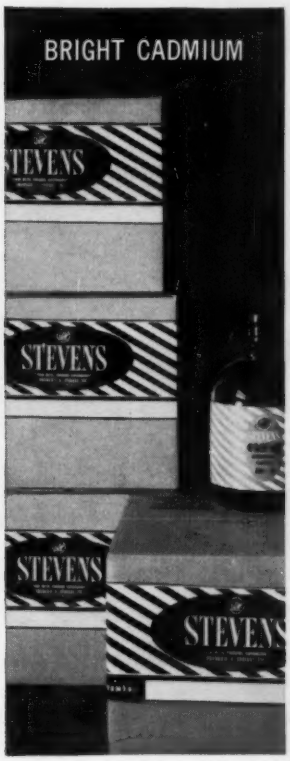
STEVENS EXPANDED MANUFACTURING FACILITIES now provide several superior plating processes, each field-proven and certified by the famous Stevens name.

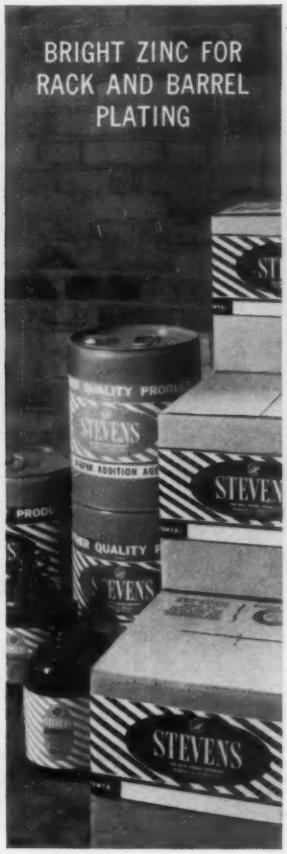
A GREATLY-ENLARGED CUSTOMER SERVICE LABORATORY permits accurate analysis and checking of solutions on a much broader scale than ever before. A skilled staff is available for immediate research assistance on all your plating problems.

STEVENS FIELD SERVICE TEAM has been increased by a number of well-qualified metal finishing technicians to give you fast, dependable on-the-job service, process and equipment recommendations.

A COMPLETE LINE OF METAL PREPARATION AND PLATING CHEMICALS, as well as supplies and anodes of all types are distributed by Stevens.

FOR IMPROVED PERFORMANCE in bright zinc, cadmium and copper plating processes, call your Stevens Representative for complete information. Write today for our informative brochure on prices, packaging and descriptive specifications.





CHEMICALS, SUPPLIES AND ANODES

frederic b. STEVENS, inc.

DETROIT 16, MICHIGAN

Buffalo · Chicago · Detroit · Cleveland · Dayton · Wallingford (Conn.) · Indianapolis · Springfield (Ohio)

2 OPERATIONS SAVED.
On base of small waffle iron, 1 cut-down operation, and 1 hand coloring operation have been eliminated through the use of Superlume.

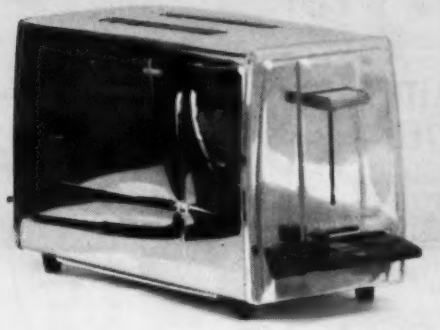
1 OPERATION SAVED.
On base of large waffle iron, 1 coloring operation is no longer necessary.

3 OPERATIONS SAVED.
On round toaster shell, 1 cut-down operation and 2 coloring operations have been eliminated.

1 OPERATION SAVED.
On the steam iron shoe, 1 hand coloring operation has been eliminated.

yet SUPERLUME vastly improves all 5 of these Son Chief products ...and at no extra cost.

says NICHOLAS J. LAZZARO, JR.
Asst. Plant Superintendent
in Charge of Finishing,
Son Chief Electrics, Inc.,
Winstead, Connecticut



HIGHER QUALITY FINISH.
On square toaster shell, same finishing operations are required with Superlume, but appearance of product is tremendously improved. On all 5 products, in fact, Superlume has stepped up product quality appreciably—and, in every instance, *at no increase in cost.*

Son Chief Electrics, Inc., appliance makers, sought a thicker, brighter plate, more rapidly applied. They found it in Superlume—along with major reductions in finishing operations, plus what Nick Lazzaro calls "Tremendous improvement in our products' appearance ... a real breakthrough in quality."

Actually, Son Chief is plating *twice* as thick in the same time as before (using 60 amps per sq. ft. instead of 30).

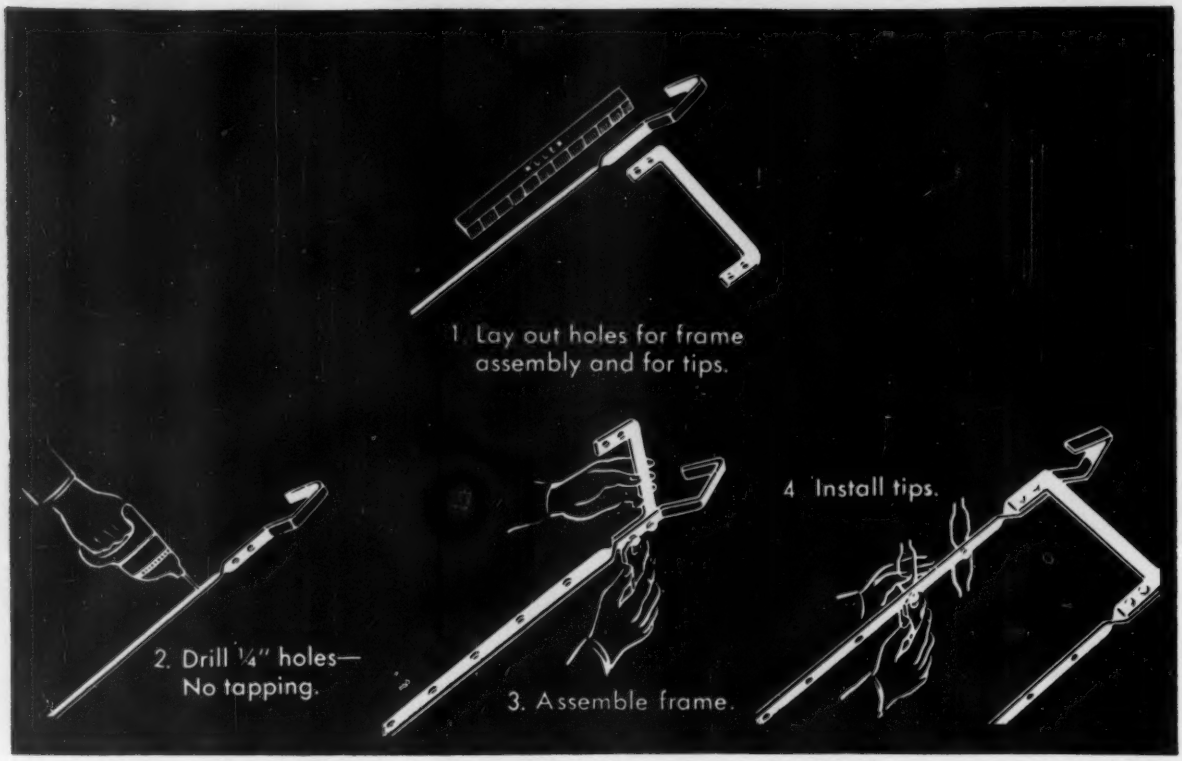
They're plating flat pieces now and forming *after* plating ... a big production advantage unique with highly ductile Superlume.

Superlume bath is easier to maintain. Son Chief's normal operating schedule is 5 days, 16 hours a day. But for two months every year, they work on a *24-hour/5-day basis.* Average pieces per hour through trouble-free Superlume: 336, with a low of 226, a high of 904. Son Chief plates 30 different parts ranging from 1 to 20 inches long. Superlume bath in use: 3100 gallons.

Good-sized operation ... healthy benefits ... no added production costs. For full facts on Superlume as applied to *your* operation, contact H-VW-M. Chances are you, too, will be better off with this better bright nickel bath.

H-VW-M
Progress in metalfinishing through advanced processes • equipment

Hanson-Van Winkle-Munning Company, Matawan, New Jersey
Offices in Principal Cities
Alert Supply Company is H-VW-M in the West • Los Angeles • San Francisco



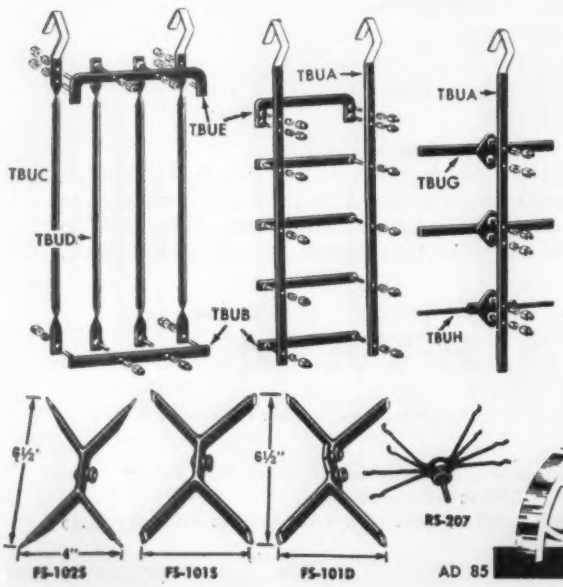
Pre-Insulated Parts are quickly assembled

Patent No. 2,820,757

BELKE THINKER BOY RACKS

Convert Waste into *Profit*

You can assemble needed rack styles with tips spaced to fit the work



FLEXIBILITY UNLIMITED

Broken tips are easily replaced.

You can change tips

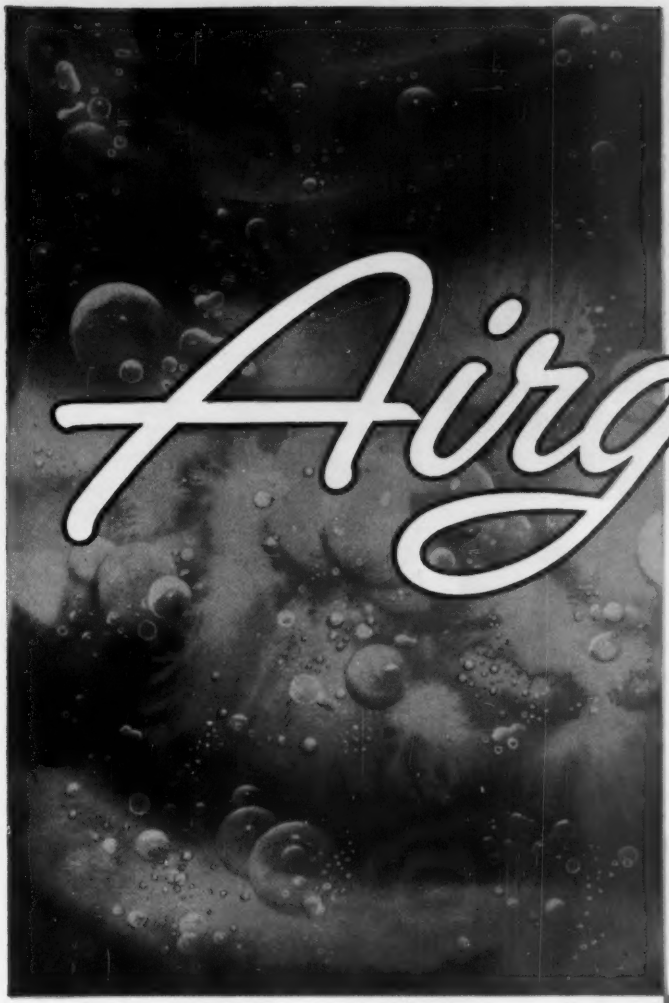
Change tip spacing.

Convert rack frames to other styles as needed

Send for the Thinker Boy Instruction Manual.

See how easy it is to assemble completely insulated racks of your own design. Get acquainted with the marvelous assortment of THINKER BOY Tips. The more you *THINK* with Thinker Boy the more you save.

Belke MANUFACTURING COMPANY
947 N. Cicero Ave., Chicago 51, Ill.
TRADE MARK
EVERYTHING FOR PLATING PLANTS



HARSHAW

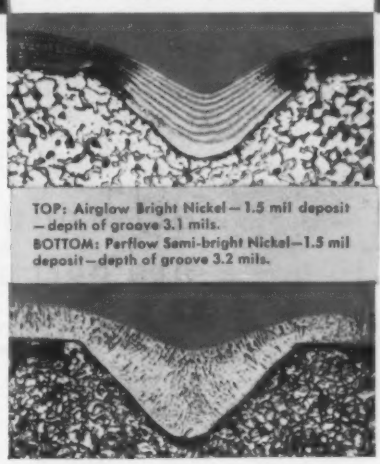
HARSHAW Airglow

AIR-AGITATED BRIGHT NICKEL PROCESS

Gives you insurance against air supply failure because it operates efficiently with any agitation system.

Airglow allows the use of current densities much higher than attainable from mechanically agitated systems.

Levelling effects of Harshaw Airglow Bright Nickel deposit compared to that of Harshaw Perflow leveling semi-bright nickel.



TOP: Airglow Bright Nickel—1.5 mil deposit—depth of groove 3.1 mils.
BOTTOM: Perflow Semi-bright Nickel—1.5 mil deposit—depth of groove 3.2 mils.

- Airglow depth of color and brightness unequalled.
- Airglow corrosion resistance—the best of any bright nickel.
- Airglow gives levelling comparable to Perflow levelling!
- Airglow gives economies unusual for bright nickel.

Let us show you!

Allow us to give you the complete story on this outstanding process by contacting the nearest Harshaw office.

THE HARSHAW CHEMICAL COMPANY

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CHICAGO 32, ILLINOIS • CINCINNATI 13, OHIO • CLEVELAND 6, OHIO • DETROIT 28, MICHIGAN • HASTINGS-ON-HUDSON 6, N.Y. • HOUSTON 11, TEXAS • LOS ANGELES 22, CALIF. • PHILADELPHIA 48, PA. • PITTSBURGH 22, PA.

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And many Agents throughout the world

Allied Research
FOR QUALITY
METAL FINISHING
PRODUCTS

a quick quiz

. . . to help you
determine if you
are getting the
most for your metal
finishing dollar.

Check your answers to these three important supplier questions. Then, compare what you get when you buy from Allied Research Products, Inc.

PRODUCT VALUE

Do I get the results I want at the lowest possible cost?

Always ☐
Sometimes ☐
Seldom ☐

Whether you want quality or economy . . . there's an Allied Research product designed to give you the best finish for the money. Specify your chemicals, equipment, or supplies for better finishing from this list:

IRIDITE ®
conversion coatings for non-ferrous metals

IRILAC ®
protective coatings for all metals

ISOBRITE ®
plating brighteners

ARP ®
process chemicals

WAGNER
electroplating equipment

Other standard plating room chemicals and supplies.

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Can I get the kind of service I want — where I want it — when I want it?

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Sometimes ☐
Seldom ☐

Allied provides a nation wide network of sales engineers and warehouses — service men and laboratories. Prompt product delivery or expert help is as close as your telephone. Check us out on promptness. Call your Allied Research man. Or, write direct if you'd like information on:

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Equipment

Supplies

KNOW HOW

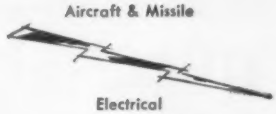
Does my supplier know my industry's finishing requirements?

Always ☐
Sometimes ☐
Seldom ☐

Allied has years of experience helping customers establish quality finishing standards. The performance of many Allied products has helped set quality levels for industry and government specifications in these industries.

Military

Aircraft & Missile


Electrical

Automotive

Appliance

Hardware

Like to have a free Value Analysis of your metal finishing operations? Write direct or call your Allied Field Representative. He's listed in the Yellow Pages under "Plating Supplies".

Allied Research Products, Inc.

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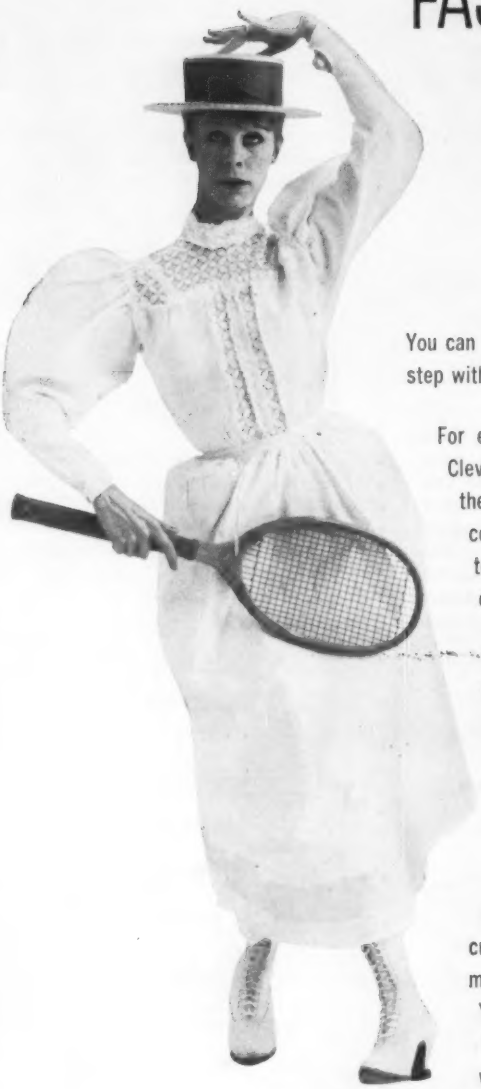
Affiliated operations in principal countries

BUSTLE-BOUND or FAST 'N' SMOOTH

how does your chrome plating stack up?



You can keep your chrome-plating process in step with today — with Diamond CPA 1800®.

For example: Viking Copper Tube Co., of Cleveland, Ohio — with mandrels plated by the CPA 1800 process — draws 1500 feet of copper tubing per minute to extremely close tolerances with almost unbelievably reduced deterioration in machine tools!

This same job-proven additive is available to you. To increase plating speed and covering power. To allow a broader operating range. To simplify anoding and produce a brighter, harder coating. To improve the metallurgical characteristics of chromium plate.

In short: Diamond CPA 1800 can cut your unit costs and save you money. Diamond developed it. Your Diamond CPA 1800 Distributor can supply it where and when you need it.

For further information write or call Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

Diamond Chemicals

At Western Electric

MEAKER AUTOMATIC DELIVERS CONSISTENT QUALITY ZINC PLATING FOR MILLIONS OF SWITCH PARTS

How large the world? No more than the minutes it takes to telephone *anywhere!* A pioneer in communications is the Western Electric Company which builds years of rugged service into every piece of telephone equipment produced at its extensive Hawthorn Works, Chicago. Superior performance is a never-ending quest of Western Electric production engineers.

The Meaker "Automatic" was chosen and installed four years ago to zinc plate switch mounting plates and relay covers. These are parts of busy telephone central offices—the communication nerve centers of offices and factories throughout the United States.

Since 1899, Meaker engineers have been building automatic metal processing equipment. These range from units tailor-made to fit limited floor space and handle modest output to the largest plating installation in the world!

Whether large or small, every Meaker is made to save its owner money—through lower labor costs, greater plating uniformity and greatly improved product quality. Send for our new catalog "When to Automate" which will give you some valuable ideas on improving your profits—and products—through automatic plating or metal finishing.

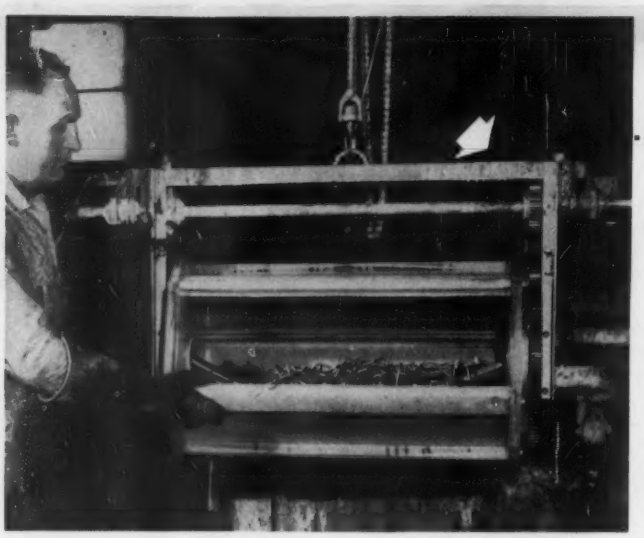
SINCE MEAKER 1899

THE MEAKER COMPANY

SUBSIDIARY OF SEL-REX CORPORATION

Nutley 10, New Jersey

Factories and offices Chicago 50, Ill., Los Angeles, Cal. and Nutley 10, N. J.



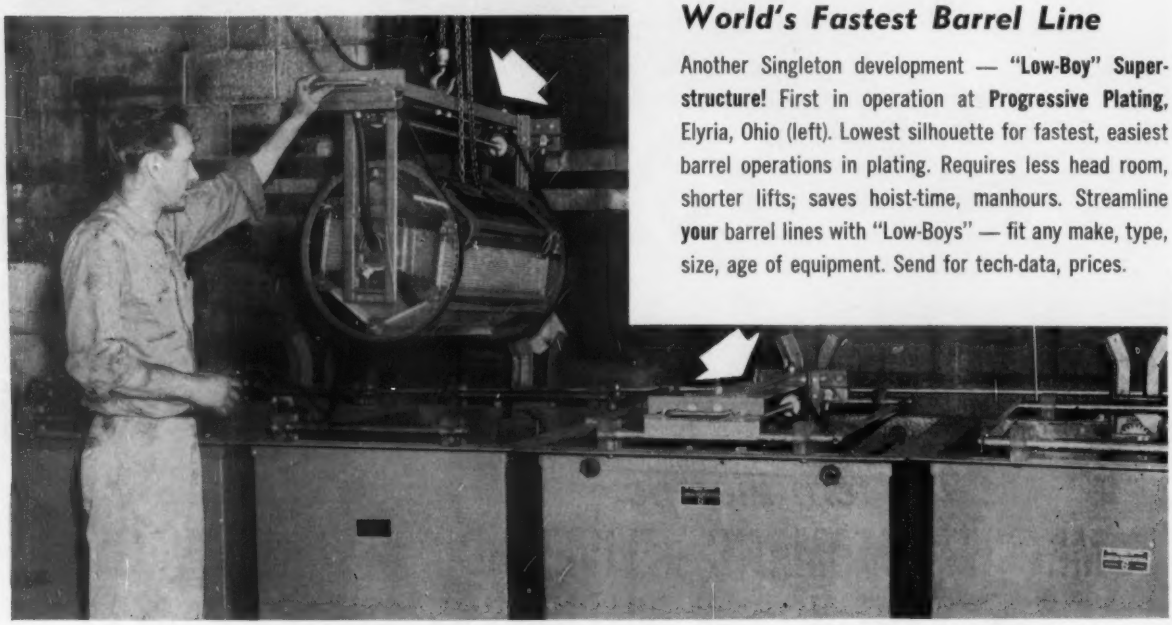
Big Moments in Plating!

World's Toughest Gear-Drive

Another Singleton development — **"Seilon" Gears!** First in operation at **Linndale Plating,** Cleveland (left). The only gear drives for 100% universal barrel plating — in **all** solutions to 220°F. (acid, alkali), for all makes, types, sizes, ages of equipment. Replace **your** old gears with Singleton "Seilons" — outperform, outlast all others — compatible with solutions many other synthetic or metal gears can't tolerate. Send for tech-data, prices.

World's Fastest Barrel Line

Another Singleton development — **"Low-Boy" Superstructure!** First in operation at **Progressive Plating,** Elyria, Ohio (left). Lowest silhouette for fastest, easiest barrel operations in plating. Requires less head room, shorter lifts; saves hoist-time, manhours. Streamline **your** barrel lines with "Low-Boys" — fit any make, type, size, age of equipment. Send for tech-data, prices.



Barrel Platers Beat Own Output Records, Cut Expenses with New Singleton Developments

"Biggest performance boost yet," is report of first barrel platers to use newest Singleton equipment. Those who follow report the same. **Performance** makes the difference. Output and quality win against time and costs. Every major plating barrel equipment advance in 20 years is a Singleton development. That's why Singleton-equipped barrel platers lead the "pack" in production, quality . . . and **profits!**

Get the facts on **Singleton Replacement Cylinders** made of the toughest "synthetics" to fit all makes, types, sizes, ages of superstructures. **Singleton Cylinder-Superstructure Units** to fit existing installations — any make, type, size, age. **Singleton "Cogged-V-Belt" Drive (or gear) Plating Barrels,** single or multi-station, allied equipment and accessories. These and others are featured in the new Singleton General Bulletin. Includes data, prices, etc. Send for it. **All protected by Singleton's U. S. Pat. 2,886,505.**

Singleton

Please contact **The Singleton Co.,** 11720 Berea Rd., Cleveland 11, Ohio.
Telephone: CLearwater 1-5580.

CREATIVE RESEARCH • QUALITY PRODUCTS • PROFESSIONAL SERVICE

an acid salt product for plating in easy-to-handle powder form

no handling hazards

no breakable carboys

Introducing PICTAX for acid pickling

New PICTAX® brings to platers a dry acid salt that is not only more convenient to use, but also provides brighter electrodeposits through better metal activation. Plating is more adherent . . . stains are eliminated . . . over-all plating quality is much improved. PICTAX has reserve acidity to give pickle baths longer life—so you don't have to change your baths as often. PICTAX is completely soluble and free-rinsing. Ask your Wyandotte representative about new PICTAX today.

Wyandotte Chemicals
J. B. FORD DIVISION
WYANDOTTE, MICHIGAN • LOS NIETOS, CALIFORNIA • ATLANTA, GEORGIA

Nickel-Chrome Plated school furniture by the Heywood-Wakefield Company, Gardner, Mass.

School furniture's built to take a beating when it's protected with Nickel-Chrome Plating

Sure, they're little angels now. But just wait till Miss Logan leaves the room. Then they really go to town and give this school furniture a workout. Desks and chairs get leaned on, stood on, kicked, dragged, banged. It all adds up to plenty of use... and abuse... every day of the school year.

Tough treatment like this calls for furniture with a really durable finish. Nickel-Chrome Plating is specified because it provides long-lasting resistance to hard wear. It keeps its bright, eye-catching appearance, fights off scratches, scrapes, bumps and stains.

Nickel-Chrome Plating works so well with so many basis metals. It gives designers true flexibility in selecting basis materials for top performance, simplified fabrication, and practical production cost. And it gives metal finishers a coating system that protects the product for years of rugged wear.

For more information on Nickel-Chrome Plating for decorative, protective finishes, write for a copy of *The Contribution of Nickel and Chromium to the Durability of Decorative Plating.* It's yours for the asking.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO **New York 5, N.Y.**

Inco Nickel *makes plating perform better longer*

brand new from top to bottom . . .

Ultrasil *rectifiers*

NEW OVERALL FUNCTIONAL DESIGN • CENTRALIZED A.C. CONTROL • SELF-LOCKING, SLIDE-IN PANELS • HINGED INSPECTION DOORS • TRIM APPEARANCE, LASTING FINISH • RUGGED UNIFRAME CONSTRUCTION • NEW, IMPROVED TRANSFORMER DESIGN • NEW, ONE-PIECE DIODE ASSEMBLY • NEW, BUILT-IN VENTILATION SYSTEM • NEW, POSITIVE PROTECTIVE DEVICES

Integral, remote and automatic controls are available. Call your Udylite Representative for complete information. Or, write:

Udylite

THE UDYLITE CORPORATION
Detroit 11, Michigan

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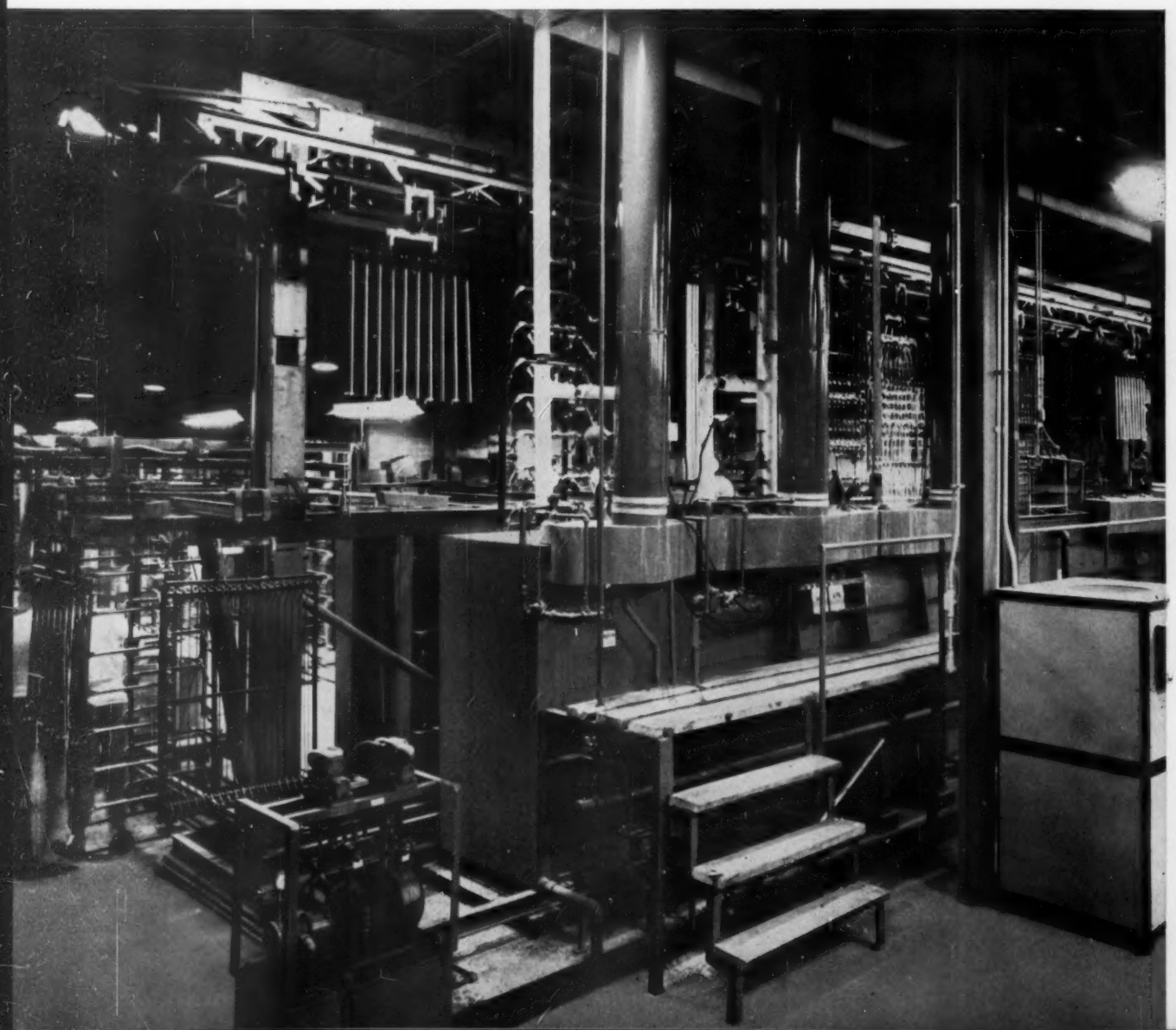
here's plating **quality** at



its finest!

Udylite Full Automatic and the Incomparable "66" put more "sell" in accessories

"Our Udylite Full Automatic is the nucleus of the largest plating plant in the notions industry," states Mr. E. Desmond Lee, President of the Lee-Rowan Company, St. Louis, Missouri. "It was selected because of our need for increased plating production and its built-in quality control." ■ The customer-stopping appearance of Lee-Rowan accessories and closet convenience items starts with the base nickel plating. The Udylite Incomparable "66" Process provides the bright finish and top leveling action required for lustrous chrome plating or jewelry finishing in 24K gold. The result is a line of metal accessories that have become top-selling impulse items in notion departments across the country. ■ The Udylite Full Automatic, in conjunction with the many superior Udylite Plating Processes, assures top finish quality at the lowest possible cost-per-unit. Ask your Udylite Representative how you can improve your product appearance, boost sales and step-up plating production. Udylite engineers will then recommend the right machine and the right process for your specific application.

The Udylite Full Automatic installed at Lee-Rowan is 83′ 5″ long, 11′ 11″ wide and has a ceiling height of 14′ 4″. Racks are 30″ x 12″ x 54″.

Udylite

THE UDYLITE CORPORATION
DETROIT 11, MICHIGAN

udylite

THAT'S RIGHT...

This cylinder will be repaired and back on the line in about 20 minutes

The New Udylok Plating Cylinders are completely field-repairable. Handy replacement parts can be inserted and the barrels returned to productive use in less than half an hour.

Ruggedly durable and dependable, Udylok is highly wear resistant under any normal use . . . yet easily repaired if damaged by accident. Its unique, interlocked, cementless construction is responsible.

There's no metal to plate in the entire cylinder . . . and *no tie rods* to corrode, rattle loose or get in the way. Parts are quickly available from Udylite or easily carried in your stock, ready for instant repairs.

Specify Udylok cylinders in all your new equipment and use them as replacements in old-style barrel units too. Let your Udylite man show you how you can apply these important economy features to *your* operation today:

The Udylite Corporation
Detroit 11, Michigan

Udylite

keep your cleaning dollars in balance

DuBois Chemicals sets the pace

DuBois delivers, in perfect proportion . . . the world's finest cleaners balanced with continuing service. The result: Concentrated cleaning at low cost plus . . . on-the-job technical assistance—*both*, from *DuBois*.

exclusive, cost-saving 6-point program

1. DuBOIS SETS THE PACE with the largest, technically-trained service group in the industry . . . to solve your cleaning problems, help train your personnel in maximum product efficiency.
2. DuBOIS SETS THE PACE with a vast number of warehouses strategically located to provide fast, efficient service.
3. DuBOIS SETS THE PACE creating the most complete line of chemical cleaning compounds . . . serving every phase of your operation.
4. DuBOIS SETS THE PACE providing almost a half-century of practical and technical "on-the-job" experience.
5. DuBOIS SETS THE PACE giving all the advancements of a research staff dedicated to formulating better cleaners for you.
6. DuBOIS SETS THE PACE providing the opportunity to unify all your purchases through one company. The result: greater dollar savings, improved service.

For Industries

Compounds for all types of metal cleaning . . . electroplating . . . paint stripping . . . paint spray booth clean-up . . . purgants . . . degreasers . . . solvents . . . automatic dispensing equipment. Products for in-plant maintenance — showers, offices, cafeterias.

DuBOIS CHEMICALS • CINCINNATI 2, OHIO

. . . so that your plant can be "ROHCO-OPTIMIZED"

for tomorrow's Super-Plating TODAY!

ROHCO-OPTIMIZATION? It means a new, *higher* standard of plating processes and results for you at *lower cost* through technologically superior ROHCO products. Why only ROHCO? Because plating process optimization is our *only* objective. No divided interests. The total, all-out efforts of our facilities are zeroed-in on *your plating problems, exclusively*. That's why ROHCO is *first* in its field in scientific *creativity* for advancing electro-finishing standards. Results? *More leading platers* depend on ROHCO products for the optimum results which only ROHCO can offer. More leading platers depend on ROHCO technical aid — from our central laboratories and from our field tech-service, both no-charge customer-service facilities. Call your nearby ROHCO representative today . . . let him go to work for you *now*. Telephone: EDison 1-5100. Send for new Catalog!

Nationwide Stockpoints

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1360 Parsons Court • Rocky River 16, Ohio

"The right start . . . a better finish"

CADMIUM PLATING PRODUCTS

ROHCO 20 XL and Super XL: World's leading cadmium brighteners.

ROHCO Cad-Sol: Add water for instant cadmium plating bath.

ZINC PLATING PRODUCTS

ROHCO 100 and ROHCO 102: Barrel zinc brighteners for brilliant, blue-white deposits.

Econobrite: Economical, bright deposits, suitable for post-plating dip.

Perma-Brites: Uniform, commercial finishes at lowest cost.

ROHCO 503: Most popular zinc brightener in plating.

ROHCO Zinc Purifier: Purges zinc plating baths — saves brightener.

ROHCO Zinc Sol: Add water for instant zinc plating bath.

ROHCO ZW-600: Wetting agent for more efficient, cleaner zinc plating.

CONVERSION COATINGS

Rodips CD-3, CD-4, CZ-10, and Roblack for cadmium: Superior post-plating treatments for passivating and coloring cadmium plate.

Rodips ZN-22, ZN-23, ZN-25, ZN-30, etc., for zinc: Superior post-plating treatments for passivating and coloring zinc plate.

Rodip AL-50 for aluminum: Superior chromate treatment imparts corrosion protection to aluminum and its alloys.

OTHER ROHCO PRODUCTS

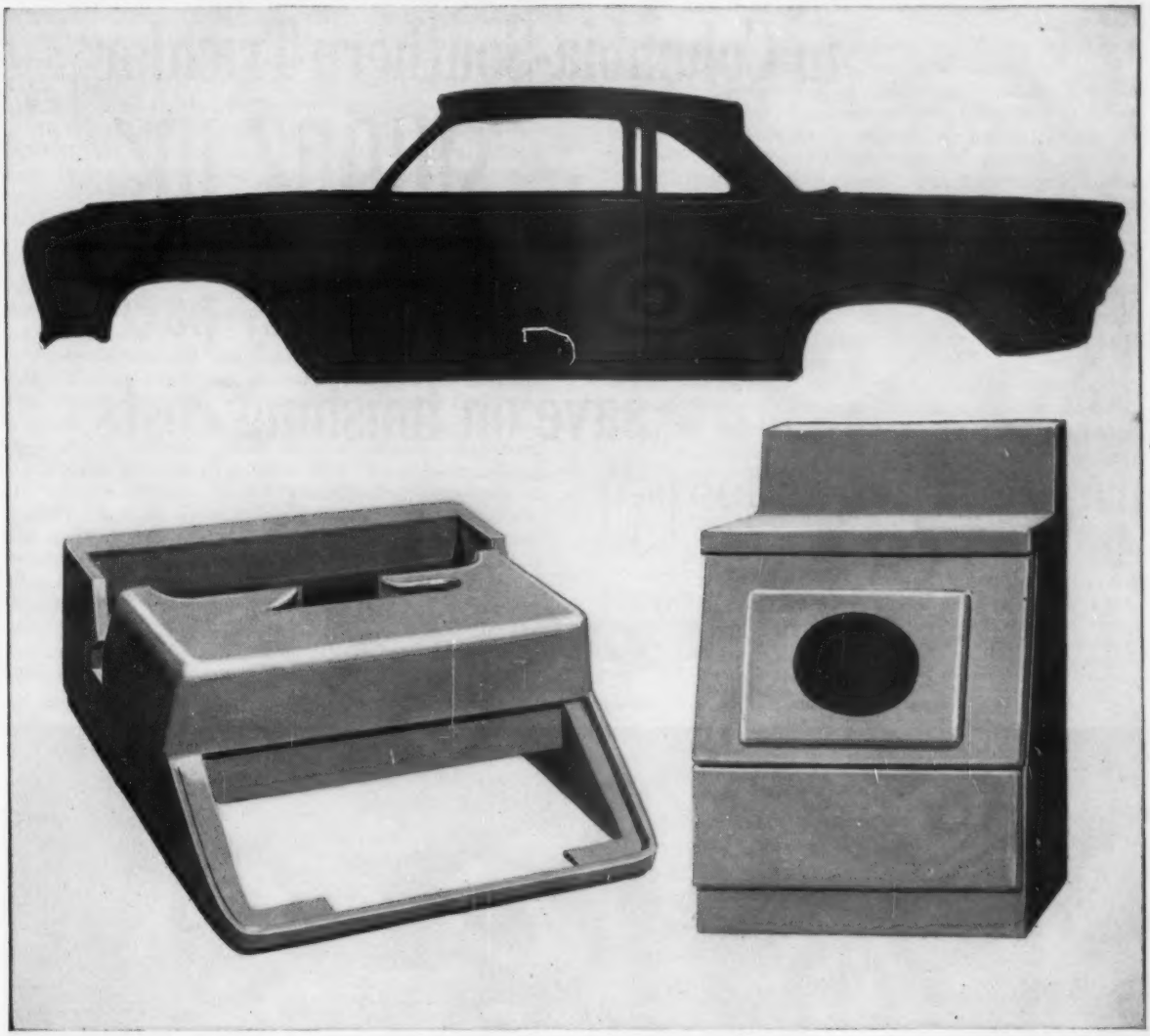
ROHCO Super No-Cro-Mist and ROHCO Anti-Spray: Spray suppressants for chromium plating baths.

ROHCO Rins-Aid: Water shedder; improves drying, prevents staining.

Rodip AL-44: Improves aluminum brite dips.

Hull Cells, Rectifiers and Related Plating Test Equipment: Wide range of models for every purpose and convenience.

What's News in Enjay Resins...



BUTON® Resins produce tough, low-cost primers!

Buton resins contribute to low-cost, long-lasting protective metal primers. Several inherent properties make them a natural choice for numerous metal priming applications. Buton resins possess excellent hardness, toughness, and flexibility . . . combined with outstanding resistance to such corrosive materials as: detergents, salt spray, boiling water, plus many acids and alkalis.

Buton resins offer excellent adhesion on most metals, including steel, galvanized steel, tin plate, aluminum, and various light metals. In addition, they provide good intercoat adhesion with conventional top coats. The initial low selling price, plus the high bulk of Buton resins make possible new savings in primer formulations. For more information, contact Enjay at 15 W. 51st St., N.Y. 19, N.Y.

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

ENJAY CHEMICAL COMPANY

A DIVISION OF HUMBLE OIL & REFINING COMPANY

ENJAY

vapor degreasing in Columbia-Southern Trichlor helps SWANK INC. set the quality pace, save on finishing costs

Natural topaz cuff link

Monogrammed tie clip and cuff link

Hand carved jade cuff link

Gleam of quality and appeal of unusual design characterize this selection of men's accessories from the Swank collection. Recent additions to the line include a full selection of small gift items and watches for men and women.

Attleboro, Massachusetts—Craftsmanship is a tradition in this New England jewelry center where Swank, Inc. produces its world-famous line of personal jewelry for men. Top quality in every price range demands care in manufacturing methods backed up with smart cost-control to keep them competitive. That's why vapor degreasing with such solvents as Columbia-Southern TRICHLOR was a natural to help Swank management meet the dual needs of effective cleaning at low cost.

Thousands of tiny parts made of all the decorative metals from brass and bronze to gold, silver, rhodium and others are buffed to a quality glow before final processing or protective plating. Since finish bespeaks quality in jewelry, no blemish-causing bits of soil could remain after the final cleaning step. The variety of metals to be processed, the tenacious buffing compounds to be removed without affecting the surface and the need for economy, gave the production department a real challenge.

Vapor degreasing was Swank's answer to the challenge. Taking advantage of modern equipment and the dependable quality of supplies like Columbia-Southern Trichlor with its heavy duty neutral stabilizing system, they were able to set up an efficient rate of continuous production without expensive shut down. Swank buys its Trichlor through Kraus Distributing Company of Providence, who also supplies other finishing materials.

A typical example of problem-solving teamwork between distributor and technical service from PPG's Chemical Division occurred recently which points up the value of well-informed suppliers. Swank was experiencing a mysterious build-up on the filters and distillation equipment which prevented proper operation of their large degreasing machine. A hurry-up call for help brought the distributor and the PPG representative. Sticking with the job until solved, they came up with the reason—an extra heavy load of insoluble spinning compound on parts being cleaned—and the solution, which involved adjusting the through-put rate and the method of work handling. Result: a return to production in a short time, with resultant savings.

Swank has found that Columbia-Southern Trichlor meets every test of quality and performance as a low-cost cleaning solvent in vapor degreasing. Trichlor is tailor-made for today's high production rates. It is produced under "Triple-check" quality control during manufacture for purity, uniformity and stability. This super-stabilized system helps protect your equipment from acid build-up. Finally, it is sold nationwide, through experienced distributors and backed up by qualified PPG Chemical Division technical service engineers. No wonder leaders like Swank of Attleboro look to Columbia-Southern Trichlor to keep them on target in efficiency and low cost.

For more details on vapor degreasing—the modern answer to metal cleaning—call your Trichlor distributor or our district office nearest you.

columbia | southern chemicals
CHEMICAL DIVISION
PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER PITTSBURGH 22, PENNSYLVANIA
DISTRICT OFFICES: Boston • Charlotte • Chicago • Cincinnati • Cleveland
Dallas • Houston • Minneapolis • New Orleans • New York • Philadelphia
Pittsburgh • San Francisco • St. Louis • IN CANADA: Standard Chemical Limited

Bill Lovenbury of Swank and Martin Kraus of Kraus Distributing Company, Trichlor distributors, inspect a rack of belt buckles which are clean, dry and ready for final plating. Swank designed many of its own work-handling racks and baskets to insure complete exposure to solvent.

Clear Trichlor flows past the sight glass after distillation, ready for more cleaning mileage. Swank has improved costs with many ingenious modifications of equipment, and increased awareness of solvent use by metering the solvent supplied to every department.

Mechanized vapor degreasing machine charged with Trichlor meets Swank's need for high production and economy. Combination of liquid spray and vapor rinse gives superior results in short time. Return conveyor system simplifies handling (one man loads and unloads) and reduces solvent loss.

MANHATTAN RUBBER LINING PROTECTS COSTLY PICKLING AND PLATING EQUIPMENT ... *Permanently*

STOP CORROSION

STOP CONTAMINATION

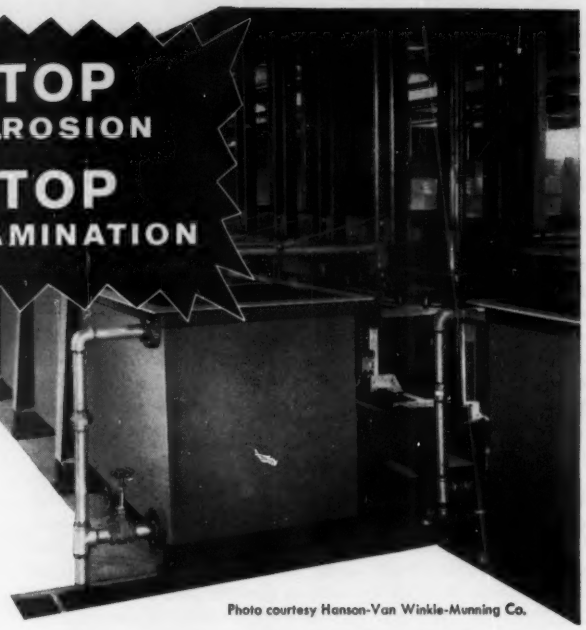


Photo courtesy Hanson-Van Winkle-Munning Co.

- THICK, MULTIPLE CALENDERED SHEETS
- INSEPARABLE RUBBER-TO-METAL BOND
- ELIMINATE DANGEROUS "STRAY CURRENTS"
- NATURAL OR SYNTHETIC RUBBER
- WON'T HARDEN, CRACK OR OXIDIZE
- TESTED UNDER HIGH VOLTAGE

Be *certain* of lifetime protection for your costly equipment and protection against contamination of expensive plating baths. Specify Manhattan lining on your next tank lining job.

MANY MANHATTAN LINED TANKS HAVE BEEN IN CONTINUOUS USE OVER 30 YEARS!

ENGINEERED RUBBER PRODUCTS .. MORE USE PER DOLLAR

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Rubber Lining Plants at Passaic, N. J. • North Charleston, S. C. • Neenah, Wis.

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new - Hi-Speed bright copper plating .. ... right out of the barrel!

BARREL COPPER Brightener ... *can be used in your present regular solution with standard equipment*

- *The only ONE brightener required — cuts operating costs*
- *Tops in throwing power — produces complete coverage immediately*
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- *Eliminates cyanide fumes*

• **A Proven Process!** •

Used successfully by job platers and manufacturers

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NON-CRITICAL BOOSTS PRODUCTION CUTS REJECTS

One of America's leading manufacturers

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- COP-BRITE
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For technical information, complete details and prices ... write to

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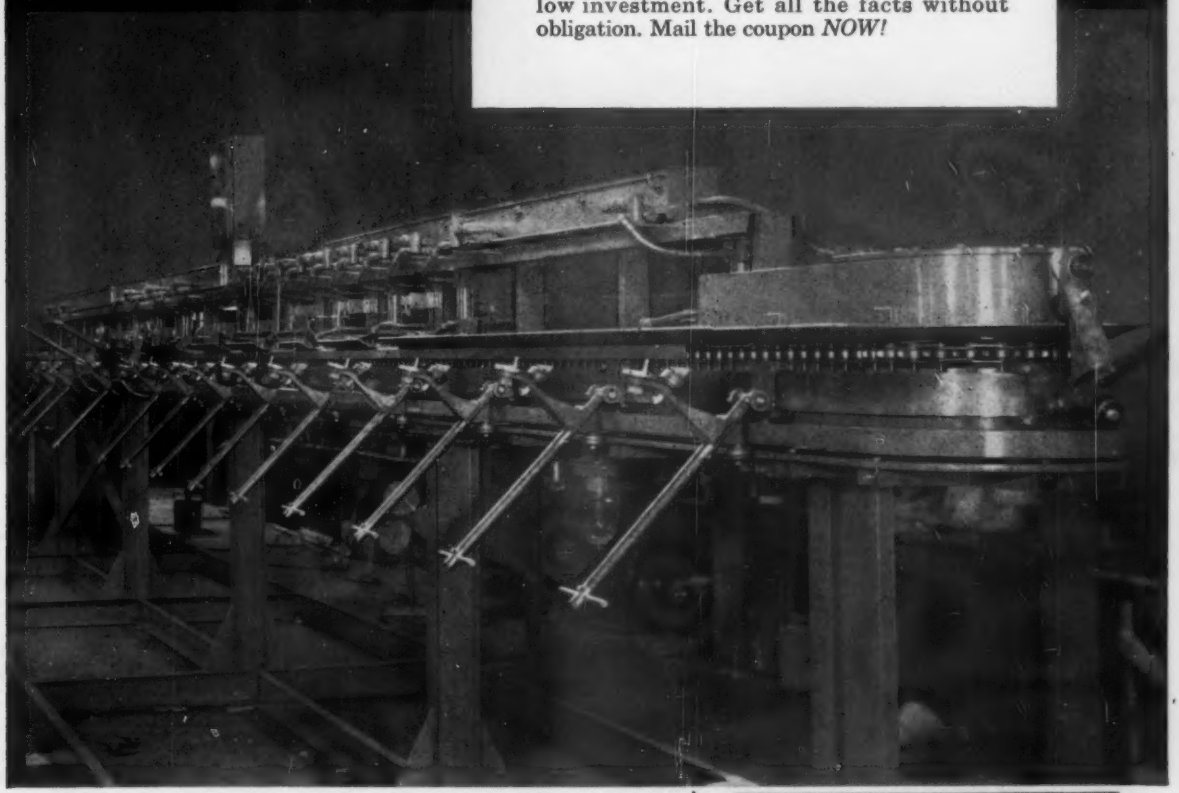
Select-O-Matic

MULTIPLE PROCESS PLATER

Up to 5 or more process cycles ...at the same time ...on one machine ...automatically!

- √ Fully automatic plating at its best . . . efficient, convenient, profitable!
- √ A single Select-O-Matic plater carries any variety of work pieces completely through 2, 3, or any other number of process cycles *simultaneously.*
- √ The operator, at the loading station, simply sets a dial on each carrier to select the process cycle for individual racks. The rest is entirely automatic while the racks travel from start to unloading.
- √ With a Select-O-Matic, different machines for each cycle are unnecessary. Saving in equipment is tremendous. Maintenance is cut to a fraction. All the floor space saved can be put to more productive use.
- √ No matter what your type of operation, Select-O-Matic is easily adaptable—at a surprisingly low investment. Get all the facts without obligation. Mail the coupon *NOW!*



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HOME OFFICE: 2820 LaSalle St. • St. Louis 4, Mo. • PRospect 1-2990
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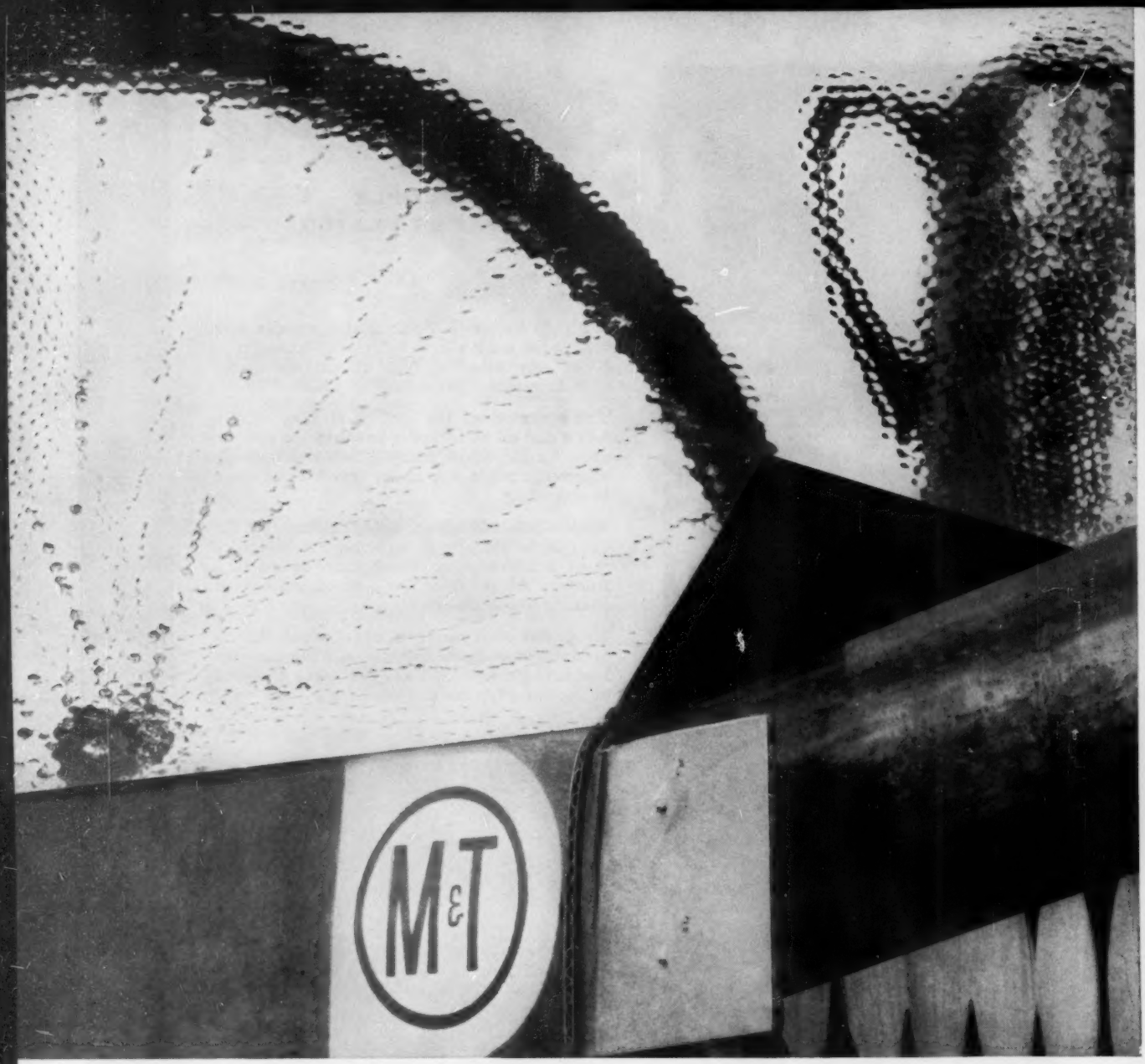
ATTACH TO COMPANY LETTERHEAD

Let us have information on the fully automatic Select-O-Matic.

Name.....

Title.....



Now...M&T Nickel Anodes...plus

THE QUALITY YOU EXPECT FROM M&T

Now ready to serve you is a new source for nickel plating supplies that takes second place to no other company in plating experience and service.

M&T has become a prime distributor for anodes made from Incobar* rolled nickel. No finer quality exists, as any experienced nickel plater knows. Their high purity and uniformity give you assurance against plating difficulties.

All types, sizes and shapes are now warehoused in convenient locations. Included are the rolled or cast 99% + carbon-types in both the oval and increasingly popular flat shapes. M&T offers high quality cotton or nylon anode bags required for nickel anode usage.

Nickel Salts, too: In addition to boric acid and M&T Addition Agents required to make up and replenish the M&T Bright Nickel 30-W Bath, you can get nickel sulfate and nickel chloride in the complete plating "package" available from M&T . . . and thereby gain the advantage of a single, responsible and experienced source of supply.

In fact, M&T is now in a position to offer you complete, undivided service responsibility for your *entire* bright plating operation...the copper and the chromium as well as the nickel...with processes that save on operating costs, with products of top quality, with service that keeps trouble out of your finishing line and rejects to a minimum.

Ask the M&T Plating Engineer for recommendations and a quotation.

*Reg. trademark of The International Nickel Company, Inc.

METAL & THERMIT CORPORATION GENERAL OFFICES: RAHWAY, NEW JERSEY IN CANADA: M&T PRODUCTS OF CANADA LTD., REXDALE, ONT.

new M&T Bright Nickel Process

...THE PLATING RESULTS YOU WANT

Here's the process you've been hearing about. Out of the M&T electroplating research laboratories has come a Watts-type bright nickel bath unexcelled in operation and economy for bright plating a variety of basis metals.

Thoroughly field-proved and already in service in a number of substantial installations, this new M&T 30-W Bright Nickel Process has shown it can deliver these advantages consistently:

- Dazzling deposits with outstanding receptivity for chromium.
- Excellent results with either air or mechanical agitation.
- Economy through long-life organic addition agents.
- A desirably ductile deposit.
- Wide bright plate range that permits highest plating speeds.
- Easy control and maintenance in production service.
- Stability of addition agents over wide pH range and other conditions.

Specific composition of the plating bath depends on operating requirements, the work to be plated, thickness wanted, etc. Individualized, *single-package* addition agents avoid control problems, assure uniform results.

M&T Addition Agent A-3 affords brightness and leveling power.

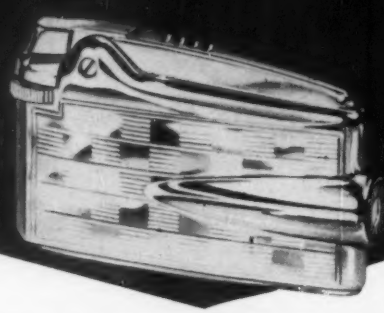
M&T Addition Agent A-5 assures maximum brilliance and ductility.

M&T Addition Agent Y-11 or Y-15 protects against pitting.

Send for data sheet that gives details.

M&T Plating Products

Another fine product made finer...



with the PARAMOUNT Finishing Touch

"It takes a fine finish to make the world's finest cigarette lighter *look* the part, says Ronson Corporation of Pennsylvania, Delaware Water Gap.

"To insure a finish that is free from surface pits, stains and streaks, we rely on Paramount Felt Wheels in our final polishing operation. We have found that Paramount Felt Wheels can consistently produce surfaces which meet our standards, yet are easy to set up and use."

Follow Ronson's lead — if finish is an important ingredient in your product

Call your Paramount Supplier today.

Bacon Felt Co. 11 Fifth Street Taunton, Massachusetts

Use

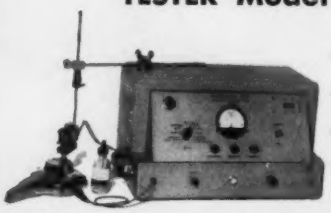
KOCOUR TEST EQUIPMENT

TO SOLVE YOUR

plating thickness problems!

You can depend on the

KOCOUR ELECTRONIC THICKNESS TESTER Model 955



- direct reading
- virtually automatic
- 90-95% accurate
- simple operation

WIDE APPLICATION RANGE!

Determines the thickness of brass, cadmium, decorative and heavy chromium, copper, lead, lead-tin, nickel, silver, tin, tin-zinc, and zinc deposits on various basis-metals. The thickness range is from 2-3 millionths up to 0.002". In addition, composite coatings can be tested. You get individual readings of the ACTUAL thickness of each deposit.
You can also test deposits on wire with Accessory Unit Model WT. (A.S.T.M. Spec. B-298-55T for testing silver coated copper wire.)

DEPENDABLE ACCURACY!

Accuracy is 90-95%. Human error is virtually eliminated. A positive "Calibration" feature monitors both accuracy and performance.

SIMPLE OPERATION!

Just set up the specimen and press a button. The average test takes about 1 minute . . . readings are direct.

15 DAY FREE TRIAL!

Try it in your own plant for 15 days. See for yourself how it works . . . what it does . . . how well it suits your application. Your satisfaction is guaranteed.

FREE EVALUATION OF APPLICATION

Just send us full details concerning your application including the plating/basis metal combinations and thickness range of each . . . or, just write for Bulletin 400. There's no charge . . . no obligation.

● KOCOUR testing sets are used all over the world for controlling plating — cleaning — pickling — anodizing — and hardening processes . . . special sets can be provided for your requirements.
Write today for complete information — no cost or obligation.

KOCOUR COMPANY
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Specify KOCOUR test sets from your supplier.

cleans steel after spot welding!

Hubbard-Hall's new 450 cleaner often eliminates an entire operation. One plater skips acid pre-pickling because 450 removes the light weld and heat scale from his spot-welded fabrications. Another uses 450 to eliminate all pickling before automatic plating. Others who used to use two cleaners before finishing use 450 instead. Besides removing grease, oil, dirt and other shop soil 450 also removes mild rust and stain. This powerful cleaner produces exceptional penetrating and soaking action. It's also low sludging, even when scale or rust is being removed, and absolutely non rusting.

Put Hubbard-Hall's new 450 cleaner to work for you. Write today for our bulletin containing complete information . . . then let us show you what 450 can do right in your plant.

PLANNED SERVICE *for better metal finishing*

THE Hubbard Hall CHEMICAL COMPANY • Waterbury, Conn.

Rhodium

ELECTROPLATING

SOLUTIONS

Rhodium electroplate is suggested for these applications: on wave guides and microwave equipment which may be used in marine atmosphere; in printed circuits; in electrical contacts where light contact pressure and low voltages are involved... Rhodium is very hard and corrosion-resistant.

This Rhodium plating solution is easy to use. It operates over a wide range of temperatures and current densities. We will be glad to plate samples without charge.

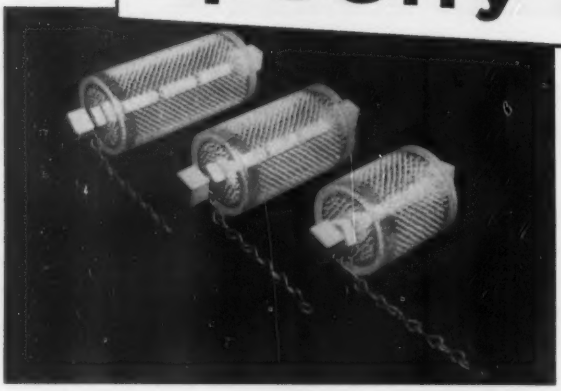
Backed by 60 Years of Specialization

Consult our staff about plating problems.

SINCE 1901

SIGMUND COHN MFG CO., INC. – 121 SOUTH COLUMBUS AVE. MOUNT VERNON, N.Y.

specify NAPCO*



NAPCO'S MITEY-MITE PLATER (only barrel of its kind)
Small loads are no longer a problem. Just load MITEY-MITE, place in your barrel and plate. Contact is made thru the work load, into a small dangler and into the MITEY-MITE. Every plater will find MITEY-MITE's quick load and unload features essential. Can be ordered in a set of 3 or a single unit —Sizes 6" - 4½" - 3".

NAPCO'S FULL CYCLE PLATING BARREL
. . . . With Plastisol covered hanger arms, 3/32" standard perforations, danglers, polypropolene ring gears and gear train, coated and uncoated superstructures. Barrel materials available in, Polypropolene, Lucite, Melamine, Bakelite. Complete stock sizes—14x30 - 14x32 - 14x36 - 15x30 - 15x36 - 16x30 - 16x36 - 18x36.

NAPCO maintains a department with complete replacement parts for ALL manufactured barrels. All items complete manufactured in our plant. (Dealers inquiries invited)

*NATIONAL PLASTICS & PLATING SUPPLY CO.

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...MUTUAL CHROMIUM CHEMICALS

Sleek, fast and high flying . . . she's a beauty, this Boeing 707 jet airliner. To help her look her best, Boeing gives the aluminum skin an anodizing treatment with Mutual® Chromium Chemicals for improved appearance and corrosion resistance.

This is just one of the many ways versatile Solvay® Mutual Chromium Chemicals serve applications ranging from metal treatment to fireworks. To fill your needs for any of the Mutual Chromium Chemicals, look to Solvay as Boeing does. Solvay is the world's largest chromium chemical producer with over 100 years' experience in their development and production.

Allied Chemical

SOLVAY PROCESS DIVISION
61 Broadway, New York 6, N. Y.

MUTUAL chromium chemicals are available through distributors and SOLVAY branch offices located in major centers from coast to coast.

For a full description of the Mutual line of chromium chemicals . . . uses, properties and comprehensive technical data . . . mail the coupon for your free copy of Solvay's new 80-page Technical Bulletin, "Chromium Chemicals."

MUTUAL CHROMIUM CHEMICALS
Sodium Bichromate • Sodium Chromate • Chromic Acid • Potassium Bichromate
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COMPLETE LINE OF PLATING AND POLISHING EQUIPMENT AND SUPPLIES

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25th year Since 1936

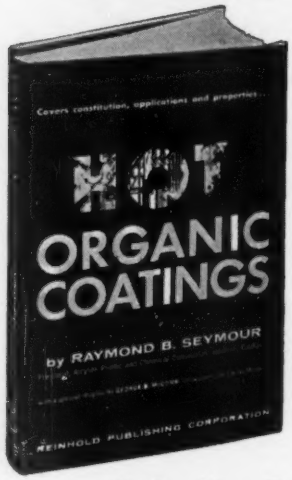
Covers constitution, applications and properties.

HOT ORGANIC COATINGS

by RAYMOND B. SEYMOUR
President, Alcylite Plastic and Chemical Corporation
With a special chapter by GEORGE B. McCOMB
Consultant to Suppliers of Pipe Line Coatings

1959, 244 pages, $7.50

The constitution, applications and properties of hot organic protective coatings are concisely presented here. The book contains chapters on widely used hot organic materials such as asphalt, coal-tar pitch, petroleum waxes and cellulose derivatives. Specific information on formulations of proprietary products is included. Additional chapters deal with hot melt applications without solvent such as peel coatings, protective linings, flame spraying and the fluidized bed process. One chapter on hot applied coal tar pitch base coatings is supplied by George B. McComb, consultant to the leading suppliers of pipe line coatings. Hot spray techniques and the many advantages of this application are also covered. This book will be helpful to everyone using these coatings in any form.



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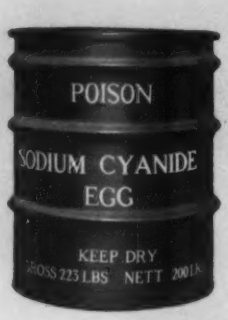

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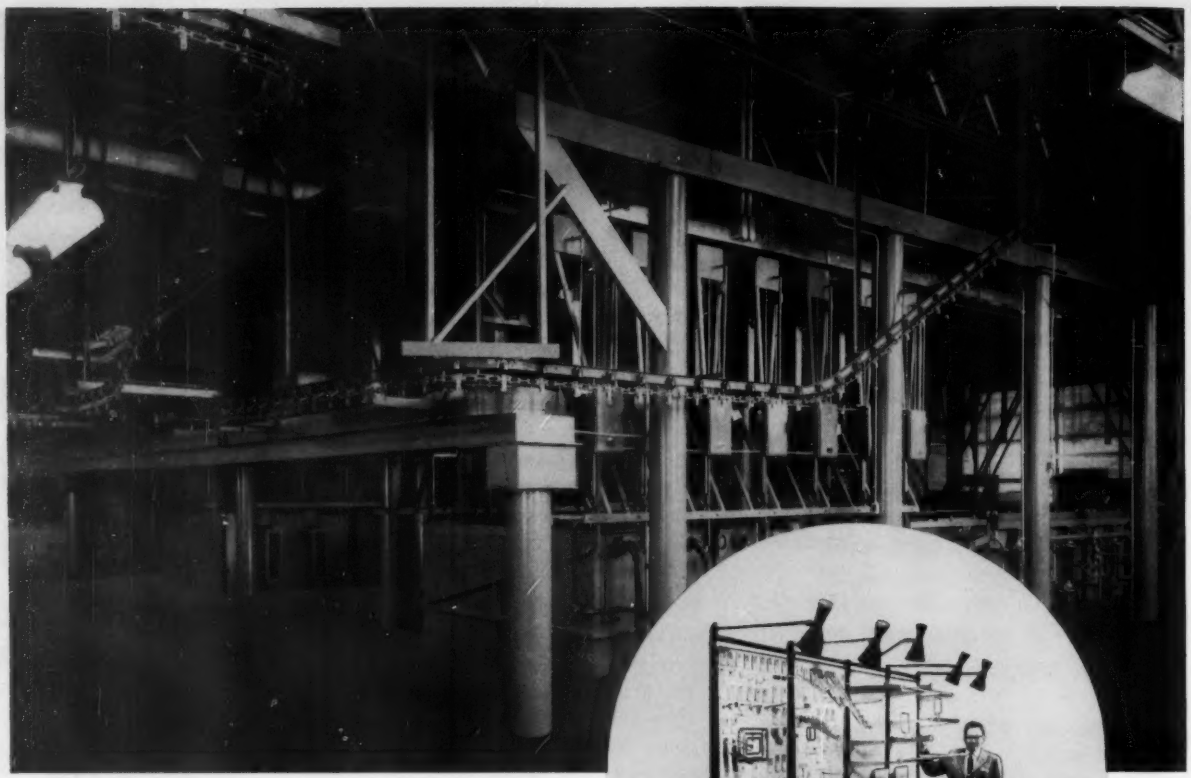

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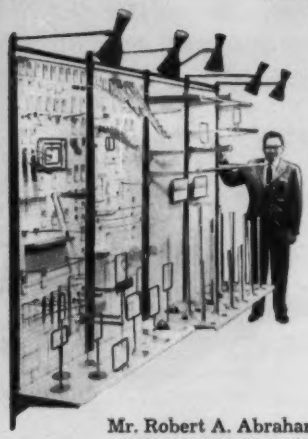

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SEPTEMBER, 1961 Volume 59 No. 9

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ESTABLISHED 1903 VOLUME 59 • NUMBER 9 • SEPTEMBER, 1961

SIGNIFICANT FIGURES

At the last I.M.F. Conference, a rather novel and simple method was reported for determining the thickness of deposit on small parts,* based on the heat developed when the deposit is dissolved in a suitable stripping solution. In outline, a number of parts of known surface area are placed in a vacuum bottle to minimize heat losses, a measured volume of strip added, and the temperature rise measured with a thermometer inserted into the solution through the bottle lid. The temperature rise is proportional to the weight of deposit dissolved and, therefore, proportional to the average deposit thickness. Where long runs of the same part are processed, a single calibration serves for routine testing over a long period. On parts where the available industrial test instruments are usually ineffective, the proposed method appears to be particularly suitable as a shop control because it requires little in the way of apparatus or operator technique.

The development is an interesting example of scientific principles, in this case calorimetry, employed in an ingenious manner to develop a simplified shop tool for the plater, and the authors of the paper are to be congratulated on their accomplishment. This reporter can also commend the Institute's practice of publishing papers prior to the meeting, which permits data to be assembled beforehand and questions to be prepared so that, after a short summary, sufficient time is available for complete discussion and rebuttal. However, the discussion left us with the distinct impression that a broad gulf still exists between the scientific approach and industrial requirement.

It was enlightening to hear questions propounded concerning the small errors introduced by thermometer stem immersion and heat loss through the walls and lid of the vacuum bottle. Considering the universally acceptable allowance of $\pm 10\%$ in commercial thickness specifications, a degree of accuracy which is not exceeded very greatly even with the microscope referee test, we are sure there is no need for concern. Any thickness test which is based on weight of deposit necessitates assignment of an assumed figure for density of the deposited metal. Even if the shape of the part permits precise determination of the surface area, variation in deposit density can introduce an error before which other sources pale into insignificance.

No plating chemist becomes a seasoned veteran until he has had occasion to see his accurately calculated recommendation of a 70 lb. sodium cyanide addition nonchalantly translated by the plater into 3½ basketfuls. We can verify that the experience is disconcerting, and even a little humiliating, but it is also, unquestionably, highly educational. It demonstrates that the degree of precision should be tailored to the needs and that, in practice, it is not always necessary to concern ourselves with the last decimal. Precision becomes ingrained in the course of formal scientific education, but rough methods and approximations are not to be deprecated if they serve the purpose.

*G. Krijl & J. L. Melse. *Trans. Inst. Met. Fin.*, **38**, *Part 1, 22 (1961)*.

Nathaniel Hall

Organic Conversion Coatings for Improved Paint and Adhesive Bonding to Aluminum Surfaces

By R. J. Lipinski, *Supervisor — Surface Treatment & Coating Section, Hughson Chem. Co., Erie, Pa.*

Introduction

THE preferred condition of aluminum surfaces prior to the application of paints and adhesives has long been a matter of considerable speculation. This is evidenced by the wide variety of mechanical, chemical and electrochemical methods reportedly used to improve the bondability of aluminum and its alloys. (cf. References 2-5). Most of these processes, such as phosphating, anodizing, etc., have long been known to provide a good mechanical type bonding base for paints and adhesives. However, because of their primary reliance on purely physical bonding forces, the resulting bond strengths are considerably lower than many present day adhesion requirements.

Other methods in current use for improving the bondability of aluminum are typified by the newer chemical processes which form polar inorganic films, such as the chromate conversion coatings. Although the adhesion potential of these chemically active films exceeds that of most mechanical bonding bases, their relatively low cohesive strength often limits the actual strength of the composite bond. This is particularly evident with newer paints and adhesives based on the more adherent, high strength resins, such as epoxies, urethanes, acrylics, etc. Since the interfacial bond strengths formed by these polymers often exceed the cohesive strength of the tightest inorganic polar films, only a fraction of their total bonding potential can be realized. The composite strengths of these bonds therefore do not necessarily exceed those of bonds formed to the better mechanical bonding bases.

Recently, a new method of chemical treatment has been developed to prepare aluminum surfaces for painting or adhesive bonding. Since the surface films produced by these treatments are organic and actually replace the natural oxide layer, they have been properly termed *Organic Conversion Coatings*. These films have a low film weight, chemical polarity, and a cathodic protective nature. Exhaustive experimentation and testing have established their ability to produce and retain bond strengths in excess of the cohesive strengths of the majority of paints and adhesives.

MECHANISM OF FORMATION:

The formation of organic conversion coatings is primarily based on the hydrogen replacement reactions which occur between mono-functional polar organic acids and aluminum surfaces. The general type equation for these reactions can be written as $2Al^{+++} + 6pRa \rightarrow 2Al(aRp)_3 + 3H_2$, where p is a polar organic group (—OH, —NH_2, etc.), R is an alkyl or aryl group, and a is a mono-functional acid group (—COOH, —SO_3H, etc.). Because of the acidic nature of solutions containing these organic reactants, either partial or complete dissolution of the natural oxide film will occur. However, since this dissolution occurs at a relatively slow rate, acidic activators such as nitrates, fluorides, etc., are normally used in order to accelerate this process.

Upon exposure of the oxide-free aluminum surface to the organic anions in solutions, the $Al(aRp)_3$ reaction products are formed. This is evidenced by hydrogen gas evolution occurring at the solution-metal interface. When the rate of formation is made to exceed the rate of solution of these products, thin colorless films, referred to as organic conversion coatings, are formed on the aluminum surface. Within the pH range of 0.5 to 2.5, the time required to form organic conversion coatings is from fifteen seconds to several minutes depending upon the method of application. Solution temperatures are usually maintained at 160 ± 10°F.

Although the thickness of these films is believed to approach mono-molecular dimensions, electrical contact resistance measurements serve to indicate their presence. These coatings have been found to maintain the contact resistance of aluminum surfaces below 300 micro-ohms per sq. cm. for periods in excess of 60 days. Thin films of this type are far less subject to cohesive failure than those which possess readily discernable film weights. The generally accepted concept is that the strength of chemically produced metal surface films decreases as film thickness increases.

Control of the thickness of organic conversion coatings is rigidly maintained by the use of various oxidizing and buffering agents. Further experimental work concerned with establishing the detailed mechanism of formation and structure of these coatings is currently in progress.

DISCUSSION OF THEORY:

Definition of Symbols

W_A = Work of Adhesion
W_C = Work of Cohesion
γ_S = Surface Tension of a Solid
γ_L = Surface Tension of a Liquid
γ_{SL} = Solid/Liquid Interfacial Tension
$\ominus$ = Angle that Water Makes with a Solid Surface

When a paint or adhesive fails to completely wet an aluminum surface, it is known to form a measurable angle with the substrate, known as the contact angle (cf. Ref. 6 & 7). Since the classical equation for Wa:

$$(1) \quad W_A = \gamma_S + \gamma_L - \gamma_{SL}$$

can be related to the polarity or wettability of an aluminum surface:

$$(2) \quad W_A = \gamma_L (1 + \text{Cos} \ominus)$$

it can be said that Wa and, therefore, the resulting bond strength is highest when the contact angle $\ominus$ is zero. Correspondingly, it can be shown that when complete wetting is obtained, as evidenced by a zero contact angle, the strength of the bond formed (W_A)

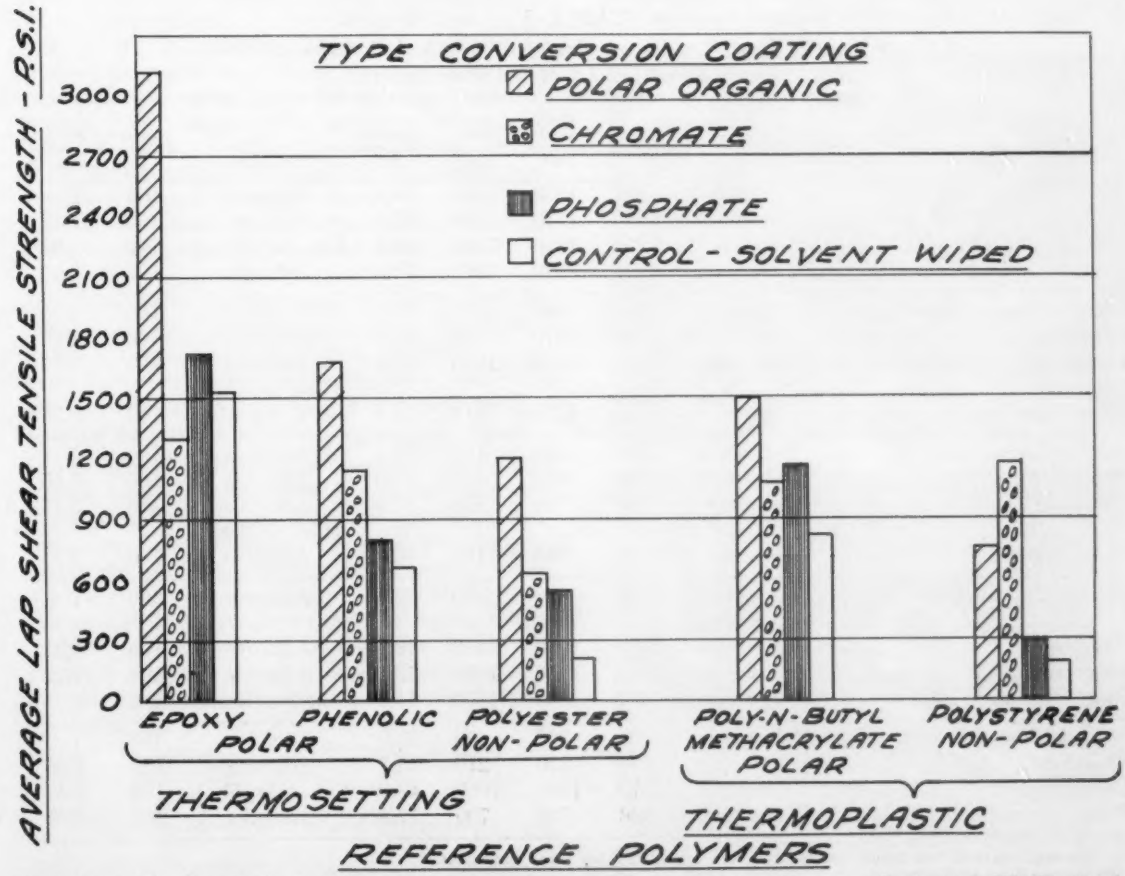

Fig. 1. Average lap shear tensile strength vs. resin type on various conversion coatings in relation to solvent wiped 2024-T3 Alclad aluminum.

is equivalent to or greater than the cohesive strength (W_C) of the applied paint or adhesive:

$$(3) \quad W_C = 2\gamma_L$$

Water, because of its high surface tension (72 dynes/cm), has been found to be ideally suited for use as the reference liquid in making contact angle measurements.[8] If water can be made to completely wet an aluminum surface, paints and adhesives with their somewhat lower surface tensions, can logically be expected to behave in a similar manner. In view of the high average contact angle (average 67°) measured on degreased aluminum surfaces, it can be seen from Equation (2) that, regardless of the relative surface tension of the paint or adhesive applied, W_A is always less than three-fourths of W_C and, therefore, the strength of the resulting bond is correspondingly less than the cohesive strength of the bonding agent. Consequently, it is evident that the bond formed is subject to mechanical interfacial failure prior to actual deterioration of the paint or adhesive film. However, when the natural oxide film is replaced with a polar organic conversion coating, a low or zero contact angle is obtained. Since complete wetting can only be achieved when $\gamma_S > \gamma_L - \gamma_{SL}$, it follows that certain of these highly polar coatings impart maximum bonding potential to aluminum surfaces.

Theory of Environmental Bond Protection

Apart from mechanical bond failure, Alstadt[9] has shown that, in the presence of moisture, both paint and adhesive bonds are subject to either short or long range deterioration due to galvanic corrosion currents developed within the bond area. It has been postulated that these corrosion currents develop as a result of measurable potential differences between surface films, such as conversion coatings and the basis metal. In instances where these surface films have been determined to be anodic with respect to the basis metal, there is considerable evidence to indicate that they provide essentially the same type of sacrificial or anodic protection as is obtained through the use of thin zinc or aluminum surface films on more electrodepositive metallic substrates. Since films of this type are known to be galvanically consumed through oxidative processes[10] in the course of protecting the underlying metal, the extent of their utility as a base for paints and adhesives is extremely limited. Phosphate coatings are an example of surface films which provide this type of anodic protection under certain environmental conditions.

In a related sense, conversion coatings which depend upon the migration of soluble chromates to the metal surface are also subject to a sacrificial type of protection mechanism. Since these soluble ions are known

TABLE I

Lap Shear Tensile Test Results on Various Chemical Conversion Coatings Applied to 2024-T3 Alclad Aluminum

Conversion Coating — Type	*Reference Adhesive*	*Av. Shear Strength PSI**	*Max. Shear Strength PSI**	*Min. Shear Strength PSI**	*Standard Deviation PSI*	*Type of Failure*	*Average Bond Area %*	*Multiple of Control***
Solvent Cleaned Control	Epoxy	1524	1630	1470	29.8	Adhesive	100	1
Phosphate	Epoxy	1718	1770	1680	15.3	Adhesive	100	1.13
Chromate	Epoxy	1292	1450	1210	43.0	Coh. (chr. film)	100	.85
Polar Organic	Epoxy	3144	3370	3060	47.0	Adhesive	100	2.06
Solvent Cleaned Control	Phenolic	660	850	610	63.7	95% Adhesive	100	1
Phosphate	Phenolic	804	970	720	35.0	95% Adhesive	100	1.22
Chromate	Phenolic	1138	1260	1050	40.4	Adhesive (Chr. to Metal)	100	1.72
Polar Organic	Phenolic	1690	1870	1610	41.5	90% Adhesive	100	2.56
Solvent Cleaned Control	Polyester	200	270	160	16.6	Adhesive	100	1
Phosphate	Polyester	530	600	470	24.0	Adhesive	100	2.65
Chromate	Polyester	630	730	530	37.6	Adhesive (Chr. to Metal)	100	3.15
Polar Organic	Polyester	1190	1230	1120	18.2	Adhesive	100	5.95
Solvent Cleaned Control	Poly-n-Butyl Methacrylate	876	920	770	22.4	Adhesive	100	1
Phosphate	Methacrylate	1158	1200	1110	13.5	Adhesive	100	1.32
Chromate	Methacrylate	1072	1130	1030	15.4	Adhesive	100	1.22
Polar Organic	Methacrylate	1482	1530	1450	15.0	Cohesive (Resin)	100	1.7
Solvent Cleaned Control	Polystyrene	181	200	70	23.9	Adhesive	100	1
Phosphate	Polystyrene	286	330	210	17.2	Adhesive	100	1.58
Chromate	Polystyrene	1172	1350	1060	43.0	Coh. (chr. film)	100	6.47
Polar Organic	Polystyrene	728	760	700	12.4	Adhesive	100	4.02

*Average value of test results on eight ASTM D1002-53T lap shear specimens.
**Solvent cleaned specimens.

TABLE II

Paint Adhesion Peel Test Results Obtained on Conversion Coatings Applied to 3003-H14 Aluminum

Vehicle Type	Method of Application	Cure Schedule	Type of Bond Failure		
			Solvent Wiped Control	Chromate	Organic
Comm. Acrylic Lacquer (Ivory)	Single Spray Coat	Air Dry—30′ at 25°C. Oven Bake—30′ at 93°C.	100% IPM	100% IPM	100% CP
Comm. Urea-Alkyd Enamel (White)	Single Roller Coat	Air Dry—30′ at R.T. Oven Bake—10′ at 150°C.	100% IPM	100% IPM	100% CP
Comm. Epoxy-Alkyd Melamine Enamel (White)	Single Spray Coat	Air Dry—30′ at 25°C. Oven Bake—30′ at 150°C.	100% IPM	100% IPM	100% CP
Comm. Vinyl-Epoxy Enamel (Gray)	Single Roller Coat	Air Dry—30′ at 25°C. Oven Bake—5′ at 150°C.	100% IPM	100% IPM	100% CP
Comm. Catalyzed Epoxy Enamel (White)	Single Spray Coat	Air Dry—30′ at 25°C. Oven Bake—30′ at 150°C.	100% IPM	100% IPM	100% CP

*IPM—Interfacial Paint-to-Metal Adhesive Failure.
CP—Cohesive Paint Failure.

to be depleted in protecting the aluminum substrate,[11] long term exposure of these films to a corrosive environment can be expected to result in either partial or complete depletion of the soluble fraction of the original film composition. Therefore, when surface films of the partially soluble or anodic type are used as a protective bonding base for either paints or adhesives, both weakened film structures and loss of adhesion or bond are likely to result.

Cathodic bond protection provided by organic conversion coatings is primarily derived from the presence of thin barrier type surface films which are cathodic with respect to the metal substrate. In terms of the theory of galvanic corrosion,[12] these films are considered to be non-sacrificial and to protect the metal by means of reducing its anodic surface character, and, thereby rendering it less susceptible to adverse environmental conditions. Therefore, these films are far more capable of providing a durable bonding base for paints and adhesives.

Although it has been established that organic conversion coatings do not protect uncoated aluminum to the same degree as high film weight sacrificial coatings, their inherent ability to form and maintain higher strength bonds throughout the useful life of a paint or an adhesive is considered to be far more pronounced. It is also noteworthy that, because of the relatively anodic character of the basis metal, with respect to organic conversion coatings, any corrosion that may develop as a result of mechanically produced breaks in the organic films will be limited to the exposed aluminum. The development of under-film corrosion is, therefore, deterred.

Experimental Studies and Discussions

Comparative Bond Potentials

ASTM D-1002-52T lap shear adhesion tests (Table I) were conducted to determine the potential bonding strength of representative conversion coatings in comparison to that of solvent-wiped aluminum.

Graphic presentation of this test data (Fig. 1) in-

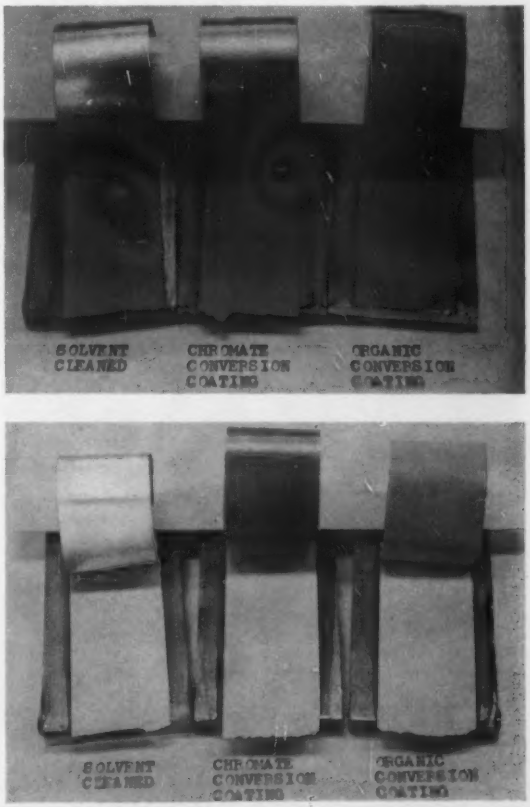

Fig. 2. Paint adhesion peel test specimens. Top row: Epon-alkyd-melamine enamel on .020" — 3003-H14 aluminum; bottom row: Acrylic lacquer on .020" — 3003-H14 aluminum.

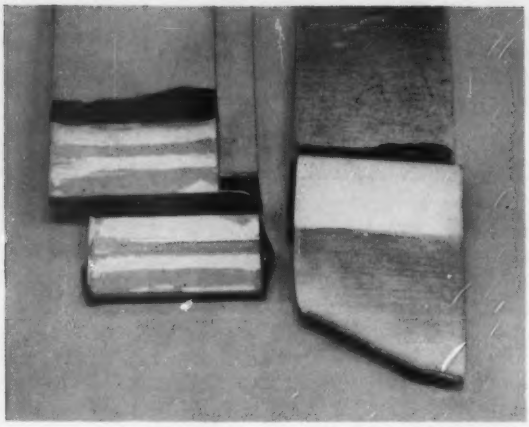

Fig. 3. Lap shear tensile specimens — .063" — 3003 aluminum. Both the WADC treated test strips (left) and the EX-A727-4 treated parts (right) were bonded using an unmodified amine-cured epoxy adhesive composition.

dicates that the shear strengths obtained on solvent cleaned aluminum provide an index of the adhesional qualities of the resinous bonding agents. This is particularly evident in view of the low bond strengths obtained with the relatively non-polar polyesters and polystyrene resins. Since these low values are suggestive of the inability of the natural oxide film to provide either a mechanical or chemical type of bonding mechanism, this substrate has apparently contributed little to the composite strength of any of the resulting bonds.

In contrast to the natural oxide film the phosphate conversion coating was found to produce a measurable increase in the bonding potential of the aluminum surface. Although the bond results show the magnitude of this increase to be relatively small, essentially the same degree of improvement was obtained with both the polar and non-polar bonding agents. This tends to confirm that the established mechanism[13] by which phosphate coatings promote adhesion is primarily mechanical rather than chemical in nature.

With the exception of poly-n-butyl methacrylate, all of the bonds formed to the chromate conversion coating resulted in cohesive failures either within the coating itself or at the conversion coating-aluminum interface. Thus the inherent bonding potential of this coating could not be definitely established. The results, however, served to show that, regardless of the levels of adhesion developed at the bond interface, the composite strength of the bond formed cannot exceed either the maximum cohesive or the adhesive strength characteristics of the conversion coating. The failure of the epoxy-chromate bond to exceed the

TABLE III

Results of Metal-to-Metal Adhesive Bonding Studies

Surface Prep. — Type*	*Composition*	*Treatment Conditions — Immersion*	*Ave. Lap Shear Tensile Strengths (PSI Values) & Standard Deviation*	
			Epoxy Type (Epon VIII)	*Vinyl Phenolic Type (FM-47 Liquid)*
Solvent Cleaned Control	Commercial Solvents	Acetone wiped and trichlorethylene degreased	2860 ± 214.7	2585 ± 166.8
Phosphate Conversion Coating	Proprietary Comp. Conc.—2 ozs./gal.	2′ at 48.9°C.	3063 ± 208.6	2160 ± 93.8
Chromate Conversion Coating	Proprietary Comp. Conc.—2 ozs./gal.	3′ at 48.9°C.	1960 ± 280.3	1717 ± 137.0
Sulfuric Acid — Dichromate Process, WADC	30 pts/wt Water 10 " Sulfuric Acid SG 1.84 1 part/wt. Sodium Dichromate	10′ at 65.6°C.	3333 ± 95.0	4167 ± 154.1
Commercial Organic Conversion Coating	Proprietary Comp. Conc.—2 ozs./gal. HNO_3 Conc.—1.5%/Vol.	5′ at 71.1°C.	3423 ± 95.0	4817 ± 125.0
Experimental Organic Conversion Coating	Proprietary Comp. Conc.—3 ozs./gal. HNO_3 Conc.—1%/Vol.	5′ at 71.1°C.	3747 ± 177.4	5107 ± 129.3

*The .063 2024-T3 Alclad panels used in this study were wiped with acetone and trichlorethylene degreased prior to treatment.

TABLE IV

Results of Metal-to-Metal Climbing Drum Peel Test On 2024-T3 Alclad Aluminum Bonded with FM-47 Tape and Adhesive*

Surface Prep. — Type	*Composition*	*Treatment Conditions — Immersion*	*Ave. Glue Line Thickness (Mils)*	*Ave. Peel Strength — Lbs./Inch*
Experimental Organic Conversion Coating — EX-A727-4	3 ozs./gal. plus .5% Vol. Conc. HNO_3	5 mins. at 160°F.	18	59.00
"	"	10 mins. at 160°F.	20	36.00
"	3 ozs./gal. plus 1%/Vol. Conc. HNO_3	5 mins. at 160°F.	18	59.00
"	"	10 mins. at 160°F.	20	34.80
"	3 ozs./gal. plus 1½%/Vol. Conc. HNO_3	5 mins. at 160°F.	21	34.26
"	"	10 mins. at 160°F.	20	30.27
Sulfuric Acid — Dichromate Process (WADC)	3 parts/wt. water, 10 parts/wt. H_2SO_4 (S.G. 1.84) 1 part/wt. Sodium Dichromate	10 mins. at 140°F.	20	32.00
"	"	10 mins. at 150°F.	22	31.00

*The FM-47 adhesive and tape were applied and cured as follows:

1. First coat of FM-47 adhesive was brush applied and air dried for 1 hr. at 25°C.
2. Second coat of CM-47 adhesive was brush applied and air dried for 16 hrs. at 25°C.
3. Both the .020" and .064" adhesive primed panels were oven dried for 1 hr. at 65.6°C.
4. The FM-47 tape was applied to the .020" test strip and the specimen assembled.
5. The assembled specimen was given a 5-minute preheat in the press at 150°C. under contact pressure.
6. Test specimens were cured for 25 minutes at 150°C. under a pressure of 100 psi.

strength of the epoxy natural oxide bond is a prime example of the limitations associated with polar coatings of the chromate type. It is further indicated that the cohesive strength of chromate conversion coatings vary in relation to the degree of penetration of these somewhat porous substrates by various bonding resins. Since polystyrene showed the highest degree of penetration and greater film reinforcement, higher cohesive strengths were obtained.

In contrast to the results obtained with the phosphate and chromate conversion coatings, the predominantly higher bond strengths produced by the organic conversion coatings were found to be more directly related to the relative polarities of the bonding agents. Because of this influence, the more absorptive chromate coating has a somewhat higher bonding potential with respect to the non-polar polystyrene resin. With slightly or highly-polar resins, however, the implied bonding potential of the polar organic coating was determined to be nearly twice that of either the phosphate or chromate coatings.

Paint Bonding

A newly designed "Paint Adhesion Peel Test" was used to measure the composite strength of paint-to-aluminum bonds. Present indirect adhesion tests (scratch, mandrel, impact, etc.) were not considered because of their limited testing capacity for the exacting demands of this study.

The method of this new test constitutes peeling a painted, flexible aluminum test strip from a rigid aluminum backing plate to which it has been bonded by a non-solvent containing organic adhesive. Typical specimens of the type prepared and tested are shown in Fig. 2.

The rigid ¼" x 1½" x 5" 6061-T6 aluminum

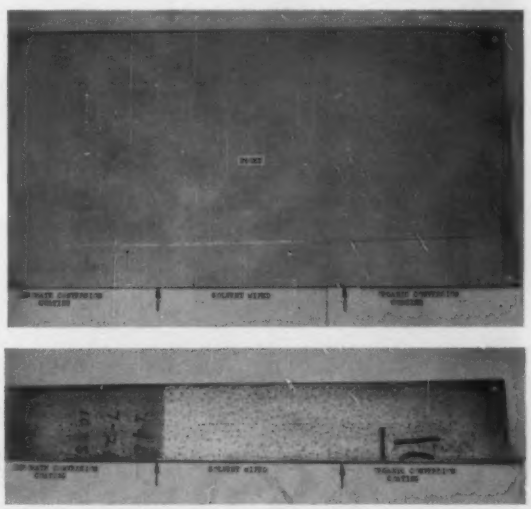

Fig. 4. Steam exposure test panels — 80% butyral — 20% phenolic coating on .064" — 2024-T3 Alclad aluminum. Panels were exposed in a steam sterilizer under 20 psi of saturated steam at 260°F. Top illustration: 24 hrs. exposure; bottom illustration: 500 hrs. exposure. These tests were conducted through the courtesy of the Case Institute of Technology.

backing plates were cleaned and treated in accordance with established procedures. Following surface preparation and painting, the .020" x 1" x 6" flexible aluminum test strips were bonded to the backing plates using a one hundred per cent solids adhesive composition. Initial glue line thickness was approximately 30 mils. The fabricated test specimens were then oven cured for two hours at 150°F. under a static five pound load applied over the length of the test strip. The test strip was then manually peeled back over the rigid substrate at a 135° angle.

In this test the strength of the paint-to-adhesive bond normally exceeds that of the cohesive strength of the paint. Therefore, paint-to-metal interfacial or cohesive paint failures are found to result.

Organic conversion coatings were evaluated in comparison to chromate conversion coatings and solvent-wiped 3003-H14 aluminum.

The test results (Table II) show that only the bonds formed to the organic conversion coating exceeded the cohesive strength of the paint films. With both the chromate conversion coatings and the solvent wiped aluminum substrates, complete paint-to-metal interfacial bond failures resulted.

The inherent strengths of the bonds obtained to the organic conversion coatings were in excess of the cohesive strength of the various paint films; moreover, these test results also illustrate that, unless bond strengths of this magnitude are obtained, either partial or complete paint-to-metal adhesive failures can result, thereby limiting the protective and/or decorative value of the paint.

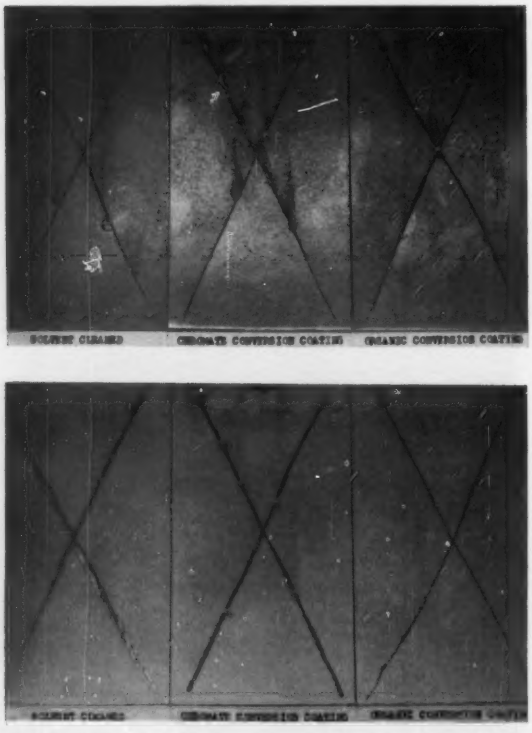

Fig. 5. ASTM B117-57 salt spray exposure, 2000 hours. Top row: epoxy-alkyd primer on 3003-H14 aluminum; bottom row: acrylic lacquer on 3003-H14 aluminum.

Metal to Metal Bonding

In view of the established importance of chemical surface treatments, such as the Sulfuric Acid-Dichromate or WADC process[14] in the formation of high strength metal-to-metal bonds, comparative adhesion studies were undertaken to determine the relative bonding potentials of various conversion coatings in this type of application.

Based on the results of ASTM D1002-52T lap shear tensile tests (Table III) conducted using a pigmented epoxy (Epon VIII) and a liquid vinyl phenolic (FM-47) as the reference adhesives, the bond strengths of the organic conversion coatings were in excess of those obtained to the modified oxide surface produced by the WADC process. With the exception of the epoxy bonds formed to the phosphate conversion coating, the strengths of the bonds formed to both the phosphate and chromate films were lower than those obtained to solvent-cleaned aluminum. These negative bonding potentials are suggestive of the generally low cohesive strength of these inorganic coatings. Partial cohesive glue line failures did occur in the bonds formed to the surface films produced by both the WADC and organic conversion coating processes. However, the glue line failures obtained on those surfaces prepared by a newer experimental organic conversion coating process were completely cohesive in nature.

In order to further investigate the relative bonding potential of the organic conversion coating produced by the newer experimental treatment in relation to the standard WADC process, climbing drum peel tests were conducted using the FM-47 tape and adhesive primer. The results of these tests (Table IV) revealed that, at the lower nitric acid concentrations (.5 to 1%) used in forming the organic coating, the peel strengths obtained were approximately twice those reported for the acid dichromate treated surfaces. At the higher nitric concentrations (1.5%), however, the peel strengths were essentially the same, indicating some passivating effect from the increased nitric concentrations. Complete adhesive-to-metal interfacial bond failures were obtained on all of the various peel test specimens. These test results indicate that, by proper control of both treatment time and nitric acid concentration, organic conversion coatings produced by means of the new process have an unusually high bonding potential for use with structural adhesives in high strength metal-to-metal bonding applications. The extent of this potential is rather vividly illustrated by means of the types of failures encountered on the lap shear tensile specimens shown in Figure 3. Whereas, the strength of the bond produced to the organic conversion coating was found to exceed the fatigue strength of the .063" — 3003 aluminum, complete interfacial bond failure was obtained with the specimen prepared using aluminum treated by means of the WADC process.

Environmental Bond Resistance:

Because of the comparatively recent development of organic conversion coatings, the exposure time thus

far obtained on outdoor weathering tests is currently of limited value in estimating their total potential bond retention characteristics. The panel shown in Figure 4, however, demonstrates that no underfilm corrosion or loss in adhesion has occurred within the maximum two-year exposure time acquired to date. The uniformity of the corrosion evident on the unpainted side of this panel (insert Figure 4) suggests that neither the extremely thin organic conversion coating nor the thin iridescent chromate coating, commonly used as a paint base, have provided any improvement in environmetal resistance over that exhibited by the solvent cleaned metal.

In order to obtain accelerated environmental resistance data on organic conversion coatings, both salt spray and steam exposure tests were conducted. Several of the salt spray test panels exposed for 2000 hours in accordance with ASTM Procedure B117-57 are shown in Figure 5.

Apart from the blisters evident on the epoxy-alkyd coated, solvent cleaned control panels, no evidence of paint failure was detected on either the organic or chromate treated substrates. In both instances, corrosion was found to be limited to the cross-hatch areas and to be somewhat more pronounced in the case of the chromate panel. On the acrylic coated panels, however, it can be seen that due to the low bond strengths initially developed to both solvent wiped aluminum and the chromate conversion coating, the amount of corrosion developed in or near the scratch area is far more pronounced than that obtained with the organic conversion coating.

These results serve to indicate that the cathodic type of protection provided by these organic films is largely instrumental in the retention of the high bond strengths obtained to both highly and moderately adherent coatings.

Further evidence as to the degree of environmental bond protection provided by cathodic coatings of this type in relation to solvent wiped aluminum can be seen from the steam exposure test panels shown in Figure 6. Attempts to peel or otherwise strip the discolored coating from one side of the scratch area on the organic treated panel showed excellent bond retention of the butyral phenolic coating to the organic substrate following 500 hours of steam exposure.

Conclusion

The development and extensive testing of organic conversion coatings have clearly established their superiority over other surface treatments for aluminum.

These coatings provide a durable bonding base for many of the newer lacquer and enamel finishes based on polar type vehicles such as acrylics, vinyls, high nitrogen alkyds, urethanes, and epoxies. Organic conversion coatings provide adhesion in excess of the cohesive strength of these finishes to assure maximum service life of these highly durable paints. Since organic conversion coatings are essentially colorless, and therefore do not appreciably alter the appearance of aluminum surfaces, their applicability as a bonding base for clear lacquers is particularly advantageous. Due to the polar nature of the majority of present-day adhesives based on phenolics, epoxies, urethanes, etc., organic conversion coatings are ideally suited for use with these compositions.

Fig. 6. Pennsylvania-Lake Erie industrial exposure, 24 months. (Acrylic lacquer on 2024-T3 Alclad aluminum.)

In summation, organic conversion coatings provide exceptionally high bonding potential and lasting environmental resistance. Their essentially colorless appearance, excellent aging characteristics, controllable film weights, and low electrical contact resistance are commercially advantageous properties. Finally, the processing facility in the formation of these coatings on aluminum is significant: short processing time; ease of solution control; absence of sludge formation; versatility in method of processing; and long solution life.

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Hydrogen Embrittlement of High Strength Steels

Recent Russian Experience

By Larissa Domnikov, *Process Analyst A, Norair Division, Northrop Corp.*

ONE of the problems which has attracted much attention in this country, but not, as yet, discussed much in Russian technical journals is the problem of hydrogen embrittlement of high strength steels as a result of electroplating. In a recent publication of "Metal Science and Heat Treatment"* at last appeared a summary of Russian scientists' experience in this field.

In the article are described the results of experiments on the determination of the effect of zinc plating from non-cyanide baths on mechanical properties of steels, also on the effect of electroplating other metals such as cadmium and copper from cyanide solutions, chromium, tin, and lead from acid electrolytes. Two types of steel were selected for testing: "U9" (0.9C) and "30CrGSA" (0.64-0.66C, 0.78-0.85 Mn, 0.22-0.23Mo, 0.24-0.28Si), with tensile strength of 175 kg./mm.^{2}.

In all tests, specimens were tested by bending, and round specimens of the "30CrGSA" steel were tested on a "Gagarin" press. Testing was conducted immediately after plating.

Zinc plating was conducted in ammoniated, sulfate, fluoborate, and zincate electrolytes. The composition of these electrolytes and plating conditions are listed in Table I.

Figures 1 and 2 show that, with increased plating time in the ammoniated solution, the plastic characteristics of steel decrease though not to the same extent as when steel parts are plated in cyanide electrolytes. At the bath temperature of 50°C. the decrease in plastic properties is less than at 20°C.

A considerable reduction in plastic properties of "U9" and "30CrGSA" steels was observed after zinc plating in a sulfate electrolyte, especially so in the presence of dextrin (See Fig. 3). Testing round specimens of "30CrGSA" steel after zinc plating in a sulfate bath indicated only an insignificant decrease in mechanical properties as a result of plating.

Testing specimens of the steels after zinc plating from a fluoborate solution showed no significant decrease in the number of bends of flat specimens, and in the mechanical properties of round specimens.

After zinc plating in a zincate electrolyte, only a small reduction in plastic properties was observed, considerably less than after zinc plating from cyanide baths.

Composition of electrolytes and plating conditions in cadmium, copper, chromium, tin, and lead plating are listed in Table 2.

Electrodeposition of copper was conducted in a

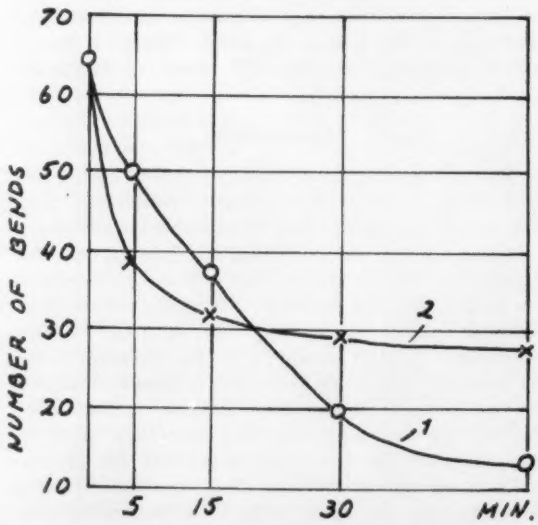

Fig. 1. Effect of plating time in ammoniated zinc electrolyte on change of properties of steel "U9": 1—20°C.; 2—50°C.

*N. T. Kudriavtsev, & I. I. Moroz. "Metal Science and Heat Treatment," No. 10 (1960).

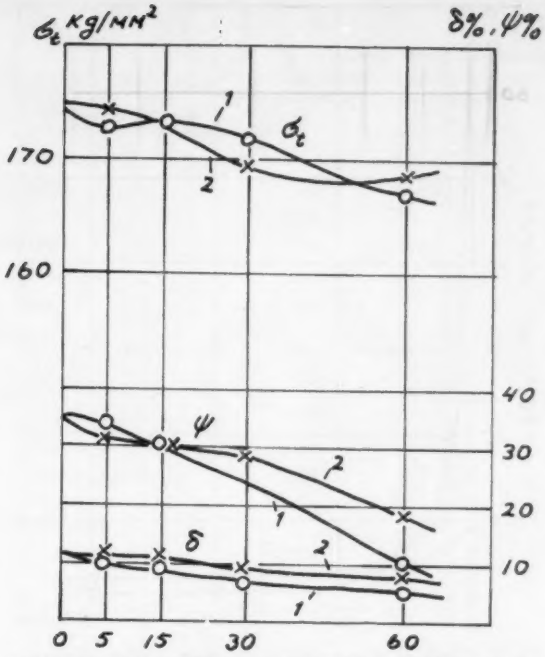

Fig. 2. Effect of plating time in ammoniated zinc electrolyte on change of mechanical properties of steel "30CrGSA": 1—20°C.; 2—50°C.

cyanide electrolyte under two sets of conditions: (1) 20°C., 0.5 amp./dm.²; (2) 35°C., 2 amp./dm.², with periodic reverse current. The ratio of the cathode period to the anode period was 14 to 1.

The effect of chromium plating was determined only for one set of conditions, commonly used in plating shops. Besides, the internal stresses which, in chromium plating, are of a considerable magnitude and undoubtedly affect the plastic properties of steel, were not taken into consideration.

As indicated by Figures 4 and 5, the number of bends of chromium plated flat specimens of "U9" and "30CrGSA" steels decreases sharply in the first few minutes of electrolysis. Reduction in mechanical properties of steel "30CrGSA" after chromium plating is also very considerable.

Discussion

In determining internal stresses arising as a result of zinc plating, no deviation of the cathode from the initial position was observed. This indicated the insignificance of internal stresses in zinc deposits and, consequently, they cannot affect the mechanical properties of steel. Therefore, it can be concluded that the reduction in mechanical properties of steel in the process of zinc electroplating is the result of hydrogen adsorption. This was supported by the results of a gas analysis[1] and agrees with the published data on

TABLE I

Composition of Electrolytes and Plating Conditions

Solution constituents	*Concentration g./l.*	*Temperature °C.*	*Current density amp./dm.²*	*Cathode efficiency %*	*Appearance of deposit*
ZnO	15				Light, mat, fine-grained
NH_4Cl	250	20	1	78	
H_3BO_3	20	50	1	85	
glue	1				
pH 6.8-7					
$ZnSO_4 \cdot 7H_2O$	215				
$Al_2(SO_4)_3 \cdot 18H_2O$	30	20	1.5	89	Light, semi-bright, coarse-grained
$Na_2SO_4 \cdot 10H_2O$	75				
pH 4-4.5					
The same as above with dextrin	10	20	1.5	89	Light, more fine-grained
$Zn(BF_4)_2$	250				Light, fine-grained, semi-bright
NH_4BF_4	25	20	5	96	
Licorice	1				
ZnO	20				
NaOH	120	50	1	94	Light gray, mat
Na_2SnO_3	1				

the absence of the influence of zinc electroplating on the fatigue life of steel.[2]

In zinc plating from non-cyanide electrolytes, a considerably smaller degree of hydrogen embrittlement of steel is observed as compared to zinc plating from cyanide baths, and reduction in mechanical properties of steel is correspondingly smaller. Evidently, it is related to a higher degree of polarization and activation of the cathode surface in cyanide electrolytes which facilities the hydrogen gas diffusion into the cathode metal. Addition of dextrin to the sulfate bath in zinc electroplating decreases the plastic properties of steel. It is well known that addition of dextrin increases the cathode polarization in sulfate electrolytes[3] and, thus, promotes hydrogen embrittlement of steel.

Investigation of non-cyanide electrolytes indicated that the degree of hydrogen embrittlement of steel in zinc plating from various electrolytes decreases in the following order: ammoniated, sulfate with the addition of dextrin, sulfate without dextrin, zincate, and fluoborate. Consequently, it is advisable to replace the cyanide electrolytes with non-cyanide electrolytes for plating important parts of non-complex design, the fluoborate solutions being best for this purpose.

Zinc plating in this electrolyte does not change the mechanical properties of steel significantly, produces good deposits, and allows higher current densities with higher current efficiency (95%).

Experiments showed that, in spite of different degrees of hydrogen embrittlement in different electrolytes, the dependence of change of mechanical properties of steel on the length of time in the plating solution has the same character. The greatest decrease in plastic properties is observed at the beginning of electrolysis. Evidently, in cadmium and copper plating, as well as in zinc plating, the reduction in mechanical properties of steel is due to hydrogen diffusion into steel. The thin deposits of cadmium and copper at the beginning of electrolysis do not prevent diffusion. As the thickness of deposits grows, the hydrogen diffusion slows down and the degree of hydrogen embrittlement decreases.

In cadmium plating from cyanide solutions, hydrogen embrittlement of steel is less than in zinc plating from cyanide solutions, the length of time in the plating solution being the same. Thus, after zinc plating from a cyanide bath for 30 minutes, the number of bends of flat specimens of steel "U9" decreased from 60 to 15 and, after cadmium plating for the same length of time, the number of bends of steel "U9" decreased from 60 to 35. If the results of these tests are compared for the same deposit thickness, for example, 15 microns, then the decrease in plastic properties of cadmium plated test specimens is even smaller: after cadmium plating, the number of bends decreased from 60 to 40 while, after zinc plating, the number of bends decreased from 60 to 15. Such a difference in hydrogen embrittlement can be explained by the fact that cadmium is deposited from cyanide electrolytes at a lower cathode polarization and with a higher cathode efficiency than zinc. Taking this into consideration, and also the high protective properties of cadmium deposits, it is advisable to use cadmium plating rather than zinc plating for the purpose of corrosion protection of important parts of complex design, provided the service conditions of such a part (temperature, absence of sulfurous gases, etc.) permits such a substitution.

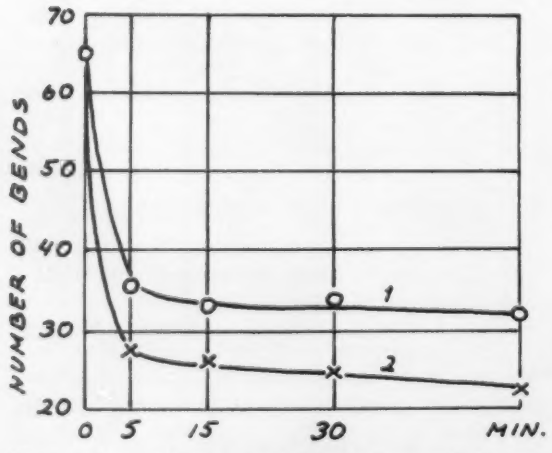

Fig. 3. Effect of plating time in zinc sulfate electrolyte on change in plastic properties of steel "U9": 1—without dextrin; 2—with 10 g./l. dextrin.

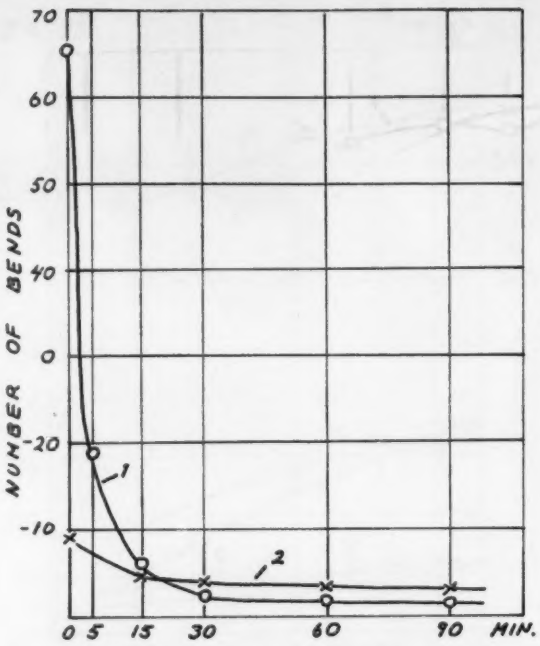

Fig. 4. Effect of plating time in chromium solution on change in plastic properties of steel "U9" (1) and steel "30CrGSA" (2).

In tin plating from acid baths or lead plating from fluoborate baths, a relatively small decrease in plastic properties of steel was also observed, as shown by the bend tests of flat specimens. The tensile tests of round specimens showed practically no decrease in mechanical properties.

As indicated in Figures 4 and 5, chromium plating sharply decreases mechanical properties of steels. Evidently, this is due not only to hydrogen embrittlement of steel but also due to hydrogen embrittlement of the deposit, which gives rise to considerable internal stresses. This is supported by the fact that the fatigue

TABLE II

Composition of Electrolytes and Plating Conditions

Solution constituents	*Concentration g./l.*	*Temperature °C*	*Current density amp./dm.²*	*Cathode efficiency %*	*Appearance of deposit*
Cadmium					
CdO	40	20	2	86	Silvery, fine-grained
NaCN	160				
NaOH	25				
$(NH_4)_2SO_4$	40				
Dextrin	10				
Copper					
CuCN	90	20	0.5	82	Light, fine-grained, bright
NaCN	100				
Na_2CO_3	60	35	2	32	
NaCN (free)	20				
Chromium		60	50	10.5	Light, smooth, bright
CrO_3	250				
H_2SO_4	2.5				
Tin					
$SnCl_3 \cdot 2H_2O$	30				
NaF	55	20	0.5	92	Silvery-white, fine-grained
HCl	1				
Gelatin	1				
Lead					
$2PbCO_3 \cdot Pb(OH)_2$	129				
HF (100%)	120	20	1	94	Gray, fine-grained, semi-bright
H_3BO_3	106				
glue	0.2				

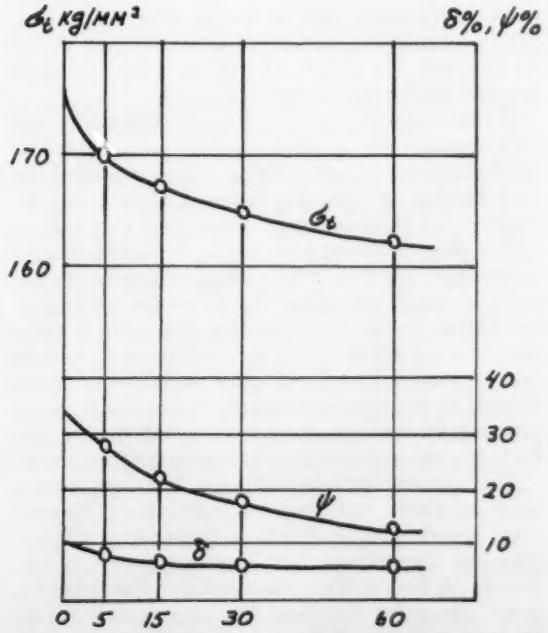

Fig. 5. Effect of plating time in chromium bath on change in mechanical properties of steel "30CrGSA".

life of chromium plated steel is also reduced.[2] This factor should be taken into consideration whenever the decision is made to use chromium plating.

Summary

1. In zinc plating from non-cyanide electrolytes the change in mechanical properties is smaller than in zinc-plating from cyanide electrolytes.

2. In cadmium or copper electrodeposition from cyanide solutions, and tin or lead plating from acid solutions, the mechanical properties of steel change to a considerably smaller degree than in zinc plating from cyanide electrolytes. The sharpest reduction of mechanical properties is observed as a result of chromium plating.

3. It is advisable to replace zinc cyanide electrolytes with non-cyanide fluoborate solutions or cadmium baths (depending on the service conditions and design of parts).

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Finishing Procedures for Magnesium and Magnesium Base Alloys

By Lester F. Spencer, *Finishing Engineer, Cleveland, Ohio*

UNCOATED magnesium base alloys are more resistant to deterioration in ordinary urban or rural atmosphere than many common structural metals. The mechanism of surface protection is normally based on the formation of a light gray film, usually consisting of a mixture of hydrated magnesium oxide and carbonate, that has the property of retarding further weathering. In many industrial applications, as exemplified by truck bodies and foundry flasks, this film generally is not objectionable.

As with other metallic materials, magnesium base alloys are subject to corrosion under certain conditions, with the result that surface protection in the form of chemical treatments, either immersion or anodic, plating procedures, and painting is required. The types of corrosion normally encountered may be classified as contact corrosion, as experienced in dissimilar metal combinations or at faying surfaces, stress corrosion cracking, surface contamination, and deterioration during storage. Contact corrosion and stress corrosion cracking are primarily related to design and, as such, can be dismissed. Surface contamination and corrosion during storage are related directly to the finisher since they affect the quality of the chemical treatment, plated coating and painted surface.

Fabricated magnesium parts frequently pick up particles of foreign material on the surface. The difficulty experienced in a paint system, due to a surface contamination, may be traced to the galvanic action that occurs in the presence of moisture, with the result of weakening an organic coating, or even a complete failure of the paint. Sources of contamination frequently are from sand, shot, or grit blasting operations, gas welding, and various resistance procedures. Another frequent source of contamination is mill scale, and scale obtained in hot working operations such as forging.

Surface Preparation

It is a foregone conclusion that surface preparation is essential to eliminate all surface contamination; the methods employed to perform this operation include mechanical cleaning, solvent and alkaline cleaning, and acid pickling.

Mechanical cleaning, which involves wire brushing, sanding, and either shot, sand, or grit blasting, are characterized by a rapid removal rate of heavy layers of oxide, casting skin, and dirt. The use of the various blasting procedures is not usually considered satisfactory; however, when this operation is mandatory, a normal follow-up operation is an acid pickling treatment. To be effective in the removal of surface contamination, at least 0.002 inch of the metal surface should be removed.

Solvent cleaning followed by an alkaline cleaning operation is used when an accumulation of an oily deposit is present on the magnesium surface. Chlorinated solvents, petroleum spirits, naphtha, lacquer thinners, and similar grease solvents have no harmful action on magnesium alloys. The choice of cleaning material will depend upon the type and degree of soil. Emulsifying cleaners, usually composed of a low-cost mineral oil distillate, are also used extensively.

There are two alkaline cleaner formulations that have proven satisfactory (Table 1). The sodium hydroxide-sodium carbonate solution is used either as an immersion bath, or cathodic; an operating pH above 11 is recommended for both bath conditions. Cleaning cathodically at a current density of 10 to 40 amp./ft.^{2} at an applied voltage of 6 requires less time than that indicated in Table 1. Parts should be cleaned until no water break occurs in the rinse. The caustic soda bath, which is operated at a pH above 13, is effective in removing graphite-base lubricants so frequently used in hot forming magnesium. Where heavy films of mineral oil are present as the contaminant, 0.1 oz./gal. of soap or a wetting agent is recommended as an addition.

Water-insoluble or non-emulsifiable substances, such as oxides, certain chemical coatings, and burned-on lubricants require acid pickling. When employed on wire brushed or blasted surfaces, it gives added assurance that all surface contamination is removed.

The chromic-nitrate bath, which is used to remove burned-on lubricants from sheet metal parts, to remove contamination caused by arc or gas welding of assemblies, and for the removal of mill scale, is operated at a pH range of 0.5 to 0.7. This bath may be revived readily by chromic acid additions to bring it back to the recommended pH range. Slight metal loss will be realized; a removal of 0.0005 inch per surface is recommended when pickling sheet products.

The chromic-nitric-hydrofluoric bath is formulated to pickle cast surfaces, particularly die-castings. The chromic acid bath is frequently preferred, since no dimensional loss during pickling is obtained. It has a film characteristic that "breaks-down" more readily than the chromic-nitrate film prior to the application of a chemical treatment. It also is used frequently for removing old chemical

TABLE I

Pickling Baths and Alkaline Cleaning Solutions

Solution Type	Sodium carbonate	Sodium hydroxide	Chromic acid	Sodium nitrate	Nitric acid, 70%	Hydrofluoric acid, 60%	Conc. sulfuric acid	Phosphoric acid, 85%	Glacial acetic acid	Operating temperature range	Exposure time	Comments
Alkaline (A) cleaning (B)	3 13	2	—	—	—	—	—	—	—	190 to 212F.	3 to 10 10 to 20 min.	Steel tanks adequately ventilated are satisfactory
Chrome-nitrate pickle	—	—	24	4	—	—	—	—	—	70 to 90F.	3 min.	Ceramic, stainless, lead lined, synthetic rubber lined tanks
Chromic-nitric hydrofluoric pickle	—	—	37.5	—	3.3	1	—	—	—	70 to 90F.	½ to 2 min.	Tanks lined with synthetic rubber or vinyl base mat'ls.
Chromic acid pickle	—	—	24	—	—	—	—	—	—	190 to 212F.	1 to 15 min.	Lead lined steel, stainless, or 2S aluminum used for tanks
Chromic-sulfuric pickle	—	—	24	—	—	—	.065	—	—	70 to 90F.	3 min.	Stainless, #1100 aluminum, ceramic, or synthetic rubber as tank material
Phosphoric acid pickle	—	—	—	—	—	—	—	.9 gal.	—	70 to 80F.	½ to 1 min.	Tanks lined with lead, glass, ceramic, or rubber
Sulfuric acid pickle	—	—	—	—	—	—	4	—	—	70 to 90F.	10 to 15 sec.	Tanks rubber lined, or made of ceramic, or lead lined
Acetic-nitrate pickle	—	—	—	6.7	—	—	—	—	25.5	70 to 80F.	½ to 1 min.	Aluminum, ceramic, or rubber lined tank

The concentrations given are in oz./gal. with the exception of the acids which are in fl.oz./gal.

treatments by alternate immersion in alkaline cleaner and acid pickle solutions.

The chromic-sulfuric bath is designed only for spot weld precleaning to obtain a consistently low surface reistance. The phosphoric acid bath is used for preparing die-cast surfaces, whereas, the sulfuric acid bath is employed on sand casting. The latter bath will effectively remove the contamination on blasted surfaces during an immersion time sufficient to remove 0.002 inch per surface. This, of course, precludes use of the bath for finished machined surfaces.

The acetic-nitrate bath is employed for parts requiring maximum protective finishing, and is effective in removing mill scale and other surface contaminants on sheet products, and in surface preparation of solution-treated magnesium castings. Metal removed per surface may range from 0.0005 to 0.001 inch and, thus, the bath is not suitable for parts requiring close tolerances. Castings that are either in the annealed or solution heat treated and aged condition should not be pickled in this bath, due to the formation of a loose, gray smut. These alloy conditions should be pickled in the chromic-nitric-hydrofluoric bath.

Mechanical Finishing

Polishing and buffing operations as a preparatory step to either plating or chemical treatment will be discussed as a unit operation for plating. The use of a polish-buff-color operational sequence to obtain a bright, metallic luster on parts designated for shelf service must be followed by a clear baked lacquer. Variations of surface finishes, as the satin, mat and butler finishes, must also have a similar surface protection medium.

A few words may be stated as to the conditions recommended[6] to obtain these variations in surface finishes for shelf service. To obtain a bright finish, the cutting-down operation on wrought products is effected with loose muslin buffs operating at a speed of 6000 to 7500 sfm; using a fast-cutting tripoli as the abrasive. The subsequent coloring operation also uses a loose muslin buff at the same speed, with a fine, dry lime-silica abrasive. In the cut-down and coloring of castings, the same wheel type and speed as given above is used; however, the abrasive for cut-down is a fused aluminum oxide powder, while coloring is obtained by

using a softer, unfused aluminum oxide grit that is relatively finer and drier.

A satin finish may be obtained at surface speeds of 3000 to 5000 sfm using loose muslin buffs, ventilated or bias buffs, string or wick wheels, with or without a lubricant, depending upon the line effect desired. The abrasive may be either a #200 aluminum oxide-silicon carbide mixture, or a 200 to 240 grit aluminum oxide. The mat finish has a frosted appearance which is obtained on a 3/8 inch sewed buff operated at a speed of about 5000 sfm. This wheel type using a 200 grit aluminum oxide will produce the required heat to realize the frosted effect. To produce a butler finish, free from surface defects, a 300 to 400 soft powder grit embedded in a special binder is used with a loose muslin buff at 3000 to 5000 sfm.

Mechanical tumbling and burnishing procedures also may be used effectively. The wet method is employed. Grinding and deburring operations require hard, marble chips, polishing the softer limestone chips, and coloring is performed with polished steel balls or shapes. The time cycle in a barrel finishing sequence should be determined by test runs. Once this is established for a given set of conditions, as to part design and processing factors, production runs will produce comparable results from batch to batch.

The use of this procedure, as described in the literature, emphasizes the economics of the process in operations such as the removal of flash and hangers from forgings in castings, deburring and burnishing. Stone[24] has illustrated the use of barrel finishing of magnesium alloys in deburring and has cited remarkable savings in the use of this procedure. One example concerned a magnesium plate, where exacting tolerances had been maintained through two barrel finishing operations within a production sequence, with a net savings of 97.6 per cent over a previous method. The load consisted of 100 parts granite chips as the abrasive medium, and water, with a time cycle of 1 hour in each instance. Large, precision parts for aircraft have also been cited, — (a) a magnesium nose section whose largest diameter was at 22 inches, a depth of 15 inches, and having a hub bore of 7¼ inches in diameter, and, (b) an intricate, magnesium plate of 20 inch diameter and 4 inch thickness. Both cases required fixturing and positioning to realize access of abrasive to all sections of the part, a No. 4 granite chip being the abrasive medium in both cases. The time savings cited was at 55 and 57 minutes per piece respectively.

Where barrel finishing is contemplated, the process requires careful consideration, due to the reactivity of magnesium alloys. Although there is no problem, one must be aware of the limitations in solution control, and base a processing cycle on experimental runs to obtain maximum results in a minimum of time.

Chemical Treatments

All of the chemical treatments will provide some protection against corrosion. However, in comparing the film characteristics of the many chemical procedures available, this category involving surface protection may be conveniently divided into:

TABLE 2 — *Chemical Treatments for Magnesium*

Dow No.	Treatment Name	Type	Treatment Used on	Appearance	Uses	Remarks
4	Chrome-alum	Chemical	Die-cast AZ91	Brown to Black	Used only as a black decorative finish for die-castings.	Offers some improvement in adhesion of paint.
8	Alkaline dichromate	Chemical	Aluminum-containing alloys, EK33, ZK60. Not used on EK30, EK41A and M1	Brown to Black	Used for black finishes on all forms. More protective on die-castings than No. 4.	Has protective and paint base qualities. Requires boiling in solution ½ hr. or more.
15	Bright finish (wrought products)	Chemical	AZ31, AZ61, AZ80, ZK60A, and M1	Silvery	Decorative finish used only on wrought magnesium.	Good 'shelf life.' Slight effect on dimensions during treatment.
16	Bright finish (Cast products)	Chemical	AZ92, AZ63, AZ91, EK30, EK41, and EZ 33	Silvery	Decorative finish used only on magnesium castings.	Good 'shelf life'. Slight effect on dimensions during treatment.
18	Phosphate touch-up	Chemical	All alloys	Medium to Dark Gray	Protective touch up treatment.	Less critical touch up than chrome-pickle (Dow No. 1).
19	Chromic acid touch-up	Chemical	All alloys	Brassy iridescent to dark brown	Protective touch up treatment.	Better inhibiting and paint-base properties than phosphate touch-up.

TABLE 3 — *Solution Composition and Operating Conditions*

Treatment	*Solution Composition*	*Operating Conditions*	*Remarks*
Bright Finish (Dow #15)	Chromic acid—24 oz./gal. Sodium nitrate—4 oz./gal. Calcium or magnesium fluoride—⅛ oz./gal.	70-90°F.; 15 seconds to one minute for pre-pickled material; 2 to 5 minutes for mat'l not pre-pickled.	Pre-pickle increases life of bright bath, and decreases time. Air agitation or mechanical stirring required. pH 0.5-0.7 Ceramic, stainless, aluminum, or lined tanks.
Bright Finish (Dow #16)	Chromic acid—37½ oz./gal. Nitric acid (70%)—3¼ oz./gal. Hydrofluoric acid (60%)—1 fl.oz./gal.	70-90°F.; 30 seconds to 2 minutes.	Air or mechanical agitation for cooling and stirring recommended.
Chrome Alum (Dow #4)	Potassium chrome alum, —4.0 oz./gal. Sodium dichromate — 13.3 oz./gal.	Boiling; 2 to 15 minutes.	Superficial layer of brown powder indication of depleted bath. Removal by wiping or tumbling.
Alkaline Dichromate (Dow #8)	Ammonium sulfate—4 oz./gal. Sodium dichromate—4 oz./gal. Ammonium hydroxide ⅓ fl.oz./gal. Dye—¼ oz./gal.	Boiling; 30 to 40 minutes; pH 5.6-6.8.	Pre-pickle or activation recommended. With dye addition, avoid foaming. Indulin dye tends to foam less, but more costly.
Phosphate Touch-up (Dow #18)	Ammonium acid phosphate —16 oz./gal. Ammonium sulfite—4 oz./gal. Denat. alcohol—8 to 20 oz./gal. Ammonia (Sp.Gr. .880)—2 fl.oz./gal.	Solution brushed on for 1 min. or dip for 1½ to 2 min. or until gassing stops. Room temperature.	Brush or spray application. Methyl alcohol may be used in formulation but is more toxic. Steel, rubber lined, glass, ceramic, or wood tanks.
Chromic Acid (Dow #19)	Chromic acid—1⅓ oz./gal. Calcium sulfate—1 oz./gal.	Room temperature; 2 to 3 minutes. pH 1.3.	Prolonged treatment produces loose, powdery coatings. *Do not use hot rinse after treatment.* Applied by brush, dip or spray.

(a) procedures designed for paint-base treatments, (b) procedures designed for a combination of purposes, as wear resistance, abrasion resistance, and/or paint-base treatment, (c) finishes that produce either a bright decorative surface or a black finish, and, (d) treatments designated as touch-up procedures. Both the paint-base treatments and the multi-purpose treatments will be discussed as a unit operation for painting. Thus, we will consider the decorative and touch-up treatments; these procedures being outlined in Table 2.

The two most widely used 'bright finish' surface treatments are designated as Dow No. 15 and 16, which produce an attractive silvery appearance. The use of this type of finish is usually for consumer goods and, in order to maintain the attractive appearance of the magnesium part, a wax coating or the preferred baked clear lacquers are applied. Since a pre-pickle in nitric acid is essential, a metal loss of about 0.0005 to 0.001 inch per surface will be obtained. The brightening treatment will also result in a metal loss of lesser magnitude, usually from 0.0001 to 0.0005 inch. This fact must be considered carefully where dimensional tolerances are important.

The operational sequence for wrought alloys would consist of the usual cleaning operations: a pre-pickle of 30 to 60 second duration in an acid solution containing 13 fl.oz./gal. nitric acid, immersion in the brightening bath, and immediate rinsing in both cold and hot water. Objectionable staining may be removed by a 30 to 60 second dip in an aqueous solution of sodium metasilicate, at a concentration of 6½ oz./gal. The operating temperature may be up to 212°F., the higher temperature facilitating stain removal.

The operational sequence for cast alloys, using Dow No. 16, is very similar to that given above. In both sequences, the finished article may be waxed or lacquered to provide a longer shelf life.

The chrome-alum treatment has been developed

(*Continued on page* 62)

Abrasive Blast Cleaning

By David E. Neustadt, *Vice President, Marketing, National Metal Abrasive Co., Cleveland, Ohio*

BECAUSE abrasive costs account for at least 30% and sometimes as much as 75% of total blast cleaning costs, selection of the one best abrasive can mean the difference between profit and loss on the entire production finishing job.

There are four prime factors which must be considered in selecting an abrasive for air, liquid, or airless cleaning. From a cost-saving standpoint, none can be taken individually; all must be balanced or compromised to produce the best results at lowest total cost.

1. Finish required
2. Abrasive consumption
3. Production rate
4. Equipment replacement costs

The same principles of shot or grit selection prevail in airless and air pressure impact cleaning, as well as the less widely used wet blasting operations. In airless cleaning, abrasive propulsion is provided by a slotted wheel; in air pressure cleaning, abrasive particles are thrown by air pressure; in wet blasting, abrasives and water are pushed by water pressure. The effects are different, but the abrasive action is substantially the same in any case.

Attainment of Finish

Since the finish required is the reason for doing the job, its attainment must be the initial factor. Cleaning efficiency is achieved not only through selection of an abrasive with proper cleaning characteristics, but also by maintaining a proper balance between impact and coverage in the operating mix.

Large pieces give maximum impact, small pieces give maximum coverage. The correct balance of impact and coverage will develop naturally as the abrasive breaks down, if proper care is given to replenishment procedure and exhaust practice. Contrary to the old idea that abrasives shatter in one step from a whole piece to dust, they actually break down into halves, quarters, eighths, and so forth. As each piece breaks, repeated impact tends to round off the broken particles.

Ineffectual "fines" are withdrawn from the system by a separator and exhaust unit. By replacing the fines exhausted from the system with new material added in small increments at frequent, regular intervals, the operating mix is held consistent. Obviously, great care must be exercised to avoid exhausting usable abrasive particles along with the fines.

For maximum cleaning efficiency and long life, the original size selected should be the largest size compatible with finish requirements. The new abrasive in the operating mix affords the maximum impact, while coverage is automatically provided by the smaller particles resulting from the breakdown of the new abrasive.

Shot is spherical, and has from two to three times the weight per particle as grit in the same size range. Therefore, it is best suited for work requiring shot

Fig. 1. Ordinary chilled iron abrasive, Rockwell C hardness 55-68. Note large amounts of massive carbide and martensitic matrix which account for rapid breakdown. Total carbon, 3%; silicon, 1.53%; phosphorus, 0.299%.

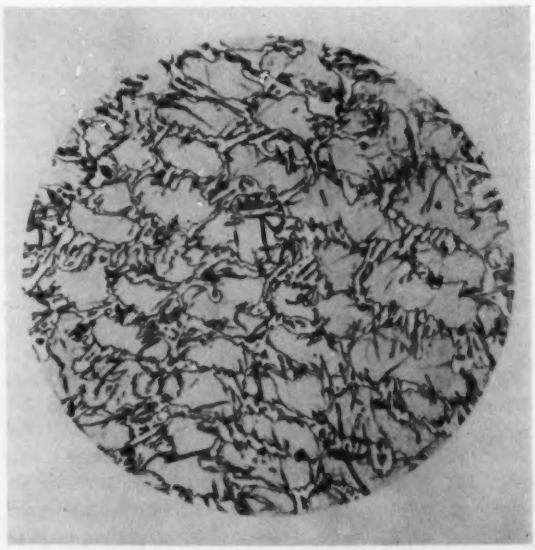


Fig. 2. Premium high carbide, ductile matrix. Rockwell C hardness 50-60. This cross-section carries iron carbide in an austenitic matrix for fast cleaning with durability. Total carbon, 2.64%; silicon 1.15%; phosphorus, 0.036%.

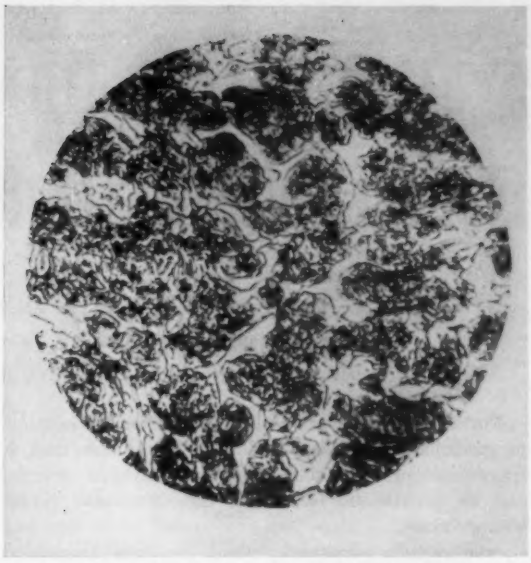


Fig. 3. Pearlitic malleable iron with retained spheroidized carbide and virtually no free graphite. Rockwell C hardness 46-54. Massive white carbide delivers fast cleaning, while pearlitic matrix gives long life. Total carbon, 2.64%; graphite carbon, 0.03%; silicon, 1.20%; phosphorus, 0.03%.

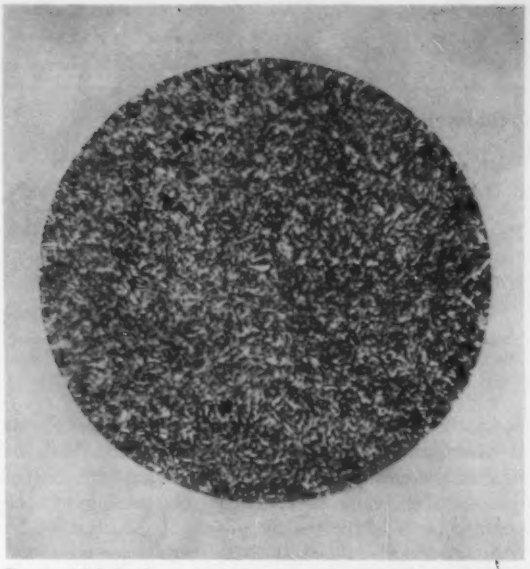


Fig. 4. High hardness steel abrasive with completely martensitic structure. Note lack of white carbide, indicating relatively low cleaning ability. Rockwell C hardness 60-67, indicating brittleness. Total carbon, 1.07%; silicon, 0.70%; phosphorus, 0.047%.

or peening action rather than cutting action for removal of surface impurities. It works like numerous, tiny ball-peen hammers, leaving the surface of the virgin metal with small indentations which become more pronounced as shot size is increased.

Grit is angular, with comparatively sharp edges and corners acting as small cutting tools. It actually scratches and opens the work surface, exposing defects which would be peened shut under the action of round shot. In larger sizes, it leaves the surface raspy and rough. In smaller ranges, it produces a velvety, mat finish. Metal surfaces to be enameled, galvanized, plated, or otherwise coated are usually best cleaned with grit, which gives a surface to which such coatings will cling easily.

Abrasive Consumption

Only accurate record keeping can deliver a true picture of abrasive life. Again, it must be emphasized that abrasive life is only one of the four important factors involved in any shot or grit cleaning process. It is axiomatic that the longer the abrasive life, the higher is the initial price and the lower is the cleaning efficiency. That is why it is important that evaluation of shot or grit should not be made on the factor of life alone.

To test a new abrasive for consumption, first simply add the new abrasive as normal replacement to the system until it equals the capacity of the equipment. For example, if the abrasive capacity of the machine is 1,000 lbs., the new shot or grit should be added to the system at normal intervals until a total of 1,000 lbs. has been added. It is at this point that production rate, quality, and consumption testing should begin. This procedure prevents operational upset and maintains a good operating mix, thus assuring proper cleaning throughout the changeover.

It is for this reason that metal finishers should never empty out an air or airless system completely, even to make a test.

Production Rate

In most metal cleaning processes, production speed can easily be increased. The primary factor in achieving an increase in production speed in blast-cleaning is selection of an abrasive with rapid cleaning characteristics. Generally, the faster cleaning abrasives have shorter life and tend to cause greater wear on the equipment.

Economies resulting from faster cleaning can be very dramatic, however, as it is possible in some cases to cut surface preparation time in half, producing savings on labor, power, and overhead and, in addition, often producing a superior finish.

Conversely, it is entirely possible to be shortchanged by switching from a fast-cleaning abrasive to a long-life, slow-cleaning type, as savings realized due to longer life can be lost several times over, due to increased cleaning time. Under normal operating circumstances, an economical balance between these variables can be maintained only when standards for the varying types of work have been established.

Again, the necessity for accurate record-keeping is apparent, simply to calculate the best cleaning practices.

Equipment Wear

Replacement parts costs and downtime of blast cleaning equipment can severely increase total cleaning costs, since they are a necessary part of production. There is no way to eliminate normal wear, but unusual wear can occur for a variety of reasons, all of which can be controlled. Chief among these is improper separator and exhaust practice. Presence of sand or extremely small metallic particles in the operating mix (due to faulty exhaust practice) will cause repair costs to skyrocket.

Abrasive Material	*Average consumption per wheel hour*	*Average price per pound*	*Abrasive cost per wheel hour*	*Approximate maintenance cost per wheel hour*	*Average labor and power costs per wheel hour*	*Total average cost per wheel hour*
Ordinary chilled iron	22 lbs.	6¢	$1.32	$1.00	$2.50	$4.82
High carbide iron with ductile matrix	11 lbs.	7½¢	$ .83	$ .60	$2.50	$3.93
Pearlitic malleable iron	8 lbs.	8¼¢	$ .66	$ .50	$2.50	$3.66
High hardness steel	11 lbs.	10¢	$1.10	$ .65	$2.50	$4.25

Shown above are those types of abrasive that afford the best balance between speed of cleaning and abrasive durability, consistent with producing the proper finish.

Another important factor in excessive repair costs is overcleaning, resulting from failure to adjust the time of the cleaning cycle to the cleaning efficiency of the abrasive being used. Such overcleaning can be avoided by reducing the time cycle of the blast, or by reducing the amount of abrasive thrown per mintue.

Ordinary chilled iron abrasives are harder than the basic wear parts of the cleaning equipment, i.e., nozzles, blades, control cages, impellers, slats, and end plates and, therefore, cause wear and tear far out of their proportion. Premium abrasives characteristically have hardnesses below that of the wear parts, accounting for both reduced maintenance costs and longer life.

Fortunately, there are a number of accurate methods to predict machine wear and abrasive consumption. A time meter, used in conjunction with simple records, can be instrumental in controlling excessive maintenance costs.

A workable, accurate method for predicting total blast cleaning costs is through the use of a table like that shown here for airless blasting. This gives the total picture and, generally, one type of abrasive stands out.

Keeping cleaning costs down can well depend on full consideration of the variables in each case. The only secret is finding the best combination of consumption, machine wear, and time to suit the finish.

FINISHING PROCEDURES FOR MAGNESIUM

(*Continued from page* 59)

specifically for magnesium die-castings; an excellent black finish is obtained with suitable racking. The coating is suitable for mild indoor exposure; however, where outdoor service of the part is anticipated, a subsequent painting operation is recommended. The operational sequence would include alkaline cleaning to remove protective surface coatings used for shipment or storage protection, mechanical and acid pickling as surface preparatory operations, immersion in the treatment bath, and suitable cold and hot rinsing.

The alkaline dichromate treatment has good protective and paint base qualities, and the coating has a slightly harder film than that obtained in the chrome-alum bath. A pre-pickle in either the hydrofluoric acid, or the acid fluoride bath is recommended, after which the part is immersed in the treatment bath. A more uniform black coating is obtained by the use of Nigrosine Black W.S. or Indulin Bluish W.S. as an addition in the treatment bath.

The hydrofluoric acid pre-pickle, which can be described as an activation bath, contains 24 fl.oz./gal. of 60% acid. Thorough rinsing is essential after activation. The acid fluoride bath, which is an aqueous solution of 6.7 oz./gal. of either sodium, potassium, or ammonium acid fluoride, is frequently used on castings that have been acid pickled after sand blasting. Both pre-pickle treatments may be used on wrought alloys.

Where parts and assemblies are too large for immersion treatments, and, where refinishing is required, the chrome pickle, the phosphate, or the chromic acid bath may be employed, a 'brush-on' procedure normally being used. The phosphate treatment is not very critical in application, the solution being applied until a continuous gray coating forms. Advantages of this procedure include (a) a minimum of pre-cleaning, involving only the removal of excessive oily matter, (b) no final water rinsing required, but desirable, and, (c) lower cost, less toxic, and more consistent in producing a foundation for painting when compared to the chrome-pickle bath.

The chromic acid touch-up has similar advantages over the chrome pickle bath and, in addition, is considered to have better inhibiting and paint-base properties than the phosphate bath. The surface should be reasonably free of oil, grease, and other corrosion products prior to brushing or spraying the touch-up solution. Cold water rinsing and oven drying are recommended. Hot water rinsing is not recommended. The color will vary with the treatment time, a 2 to 3 minute cycle to produce a dark brown coating which is preferred for ultimate paint adhesion. Pertinent facts as to solution composition and operating conditions are tabulated (Table 3).

(To be continued)

(All references will appear with Part III)

Anti-Seize Coatings for Chrome Alloy Bolts at Elevated Temperatures

By W. B. Stephenson, Jr., *Manufacturing Engineering Research Lab., General Electric Co., Cincinnati, Ohio*

THE A-286 alloy (Fe 55, C 0.05, Cr 15, Ni 26, Mo 1, Ti 2, Al 0.2), while developed for high temperature work, has a problem common to all high chrome-bearing alloys when used for bolting. A refractory oxide forms on the surface, resulting in higher and higher frictional values. In many applications this causes no more trouble than the use of a heavier wrench and a little more muscle. However, where remote handling is a necessity because of position or radio-activity, "beefing-up" of tooling cannot always be accomplished. The obvious answer is to find some way of lubricating the threads, preferably permanently.

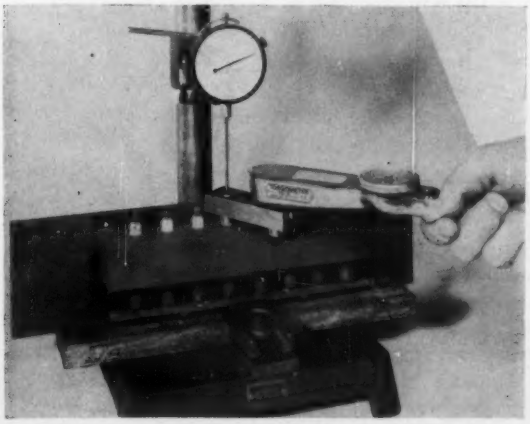
A ¼" - 28 bolt (unplated A-286) and silver plated nuts with a self-locking feature, were used as the standard test specimens.

Three sets of silver nuts and A-286 bolts (8 bolts to a set) were placed in a special fixture and were torqued to three different bolt extensions, namely, 0.1% (1.5 mils), 0.2% (3 mils), and 0.3% (4.5 mils). The running torque, the seating torque, and the release torque were measured. It was decided to use the 0.20" extension as this more nearly duplicated actual bolting conditions and yet gave a fairly uniform torque value that was mid-scale.

A set of eight nuts and bolts were placed in the fixture and torqued to 0.2". The fixture was placed in a circulating draw furnace and heated to 1000°F., held for 7 hours, and then allowed to furnace-cool overnight. The fixture was removed and the nuts released. The release torque was noted. A preliminary single cycle was run on the various combinations reported below to pick the most promising for cycling tests. The various combinations tried were as follows:

Bolt	Cycles	Nut	Av. Breakaway Torque, In.-Lbs.
Bronze	1	A-286	240*
Silver	1	A-286	202**
Rhodium	1	Silver	321
Platinum	1	Silver	255
Bronze	1	Silver	278
Nickel	1	Silver	269
Bronze	1	Bronze	250
A-286	0	Platinum	Bolt breaks***
A-286	0	Rhodium	Bolt breaks***
Nickel	0	Bronze	Bolt breaks***
A-286	5	Silver	250
Silver	5	Silver	222
Graphite suspension	6	Silver	182
Graphite-resin film A.	5	Silver	286
Graphite-resin film B.	5	Silver	309
Silver + penetrating oil	2	Silver	148

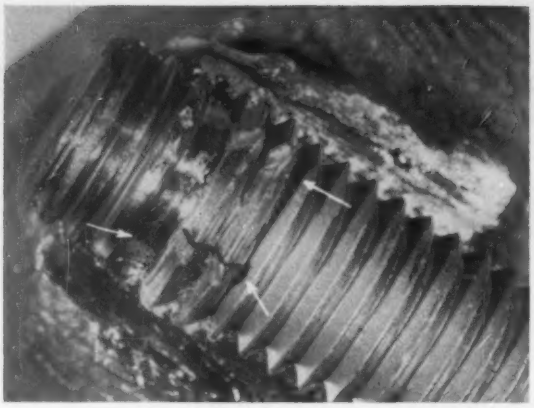
*Values from 180 to 300.
**Values from 100 to 260.
***Nut would seize as soon as locking feature acted and bolt would wring off.



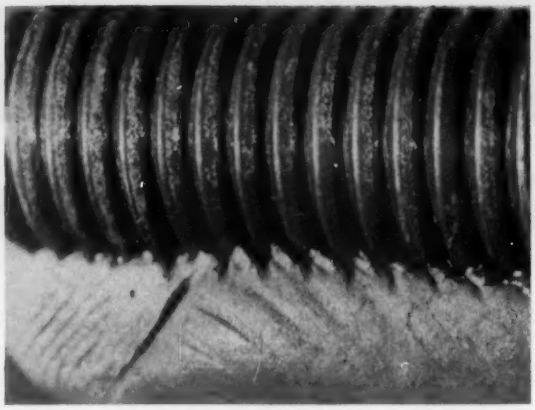
Method of measuring torque and extension simultaneously.

Although the first two combinations in the list have a better average than the base combination of A-286 bolt and silver nut, they were not selected for cycling tests because of widely fluctuating results. Since equipment must be designed to handle the maximum torque expected, it is obviously better to have as little spread as possible between the high and low values. The graphite-resin filmed bolts were cycled out of pure curiosity. They exhibited marked improvement as the cycles continued.

The combination of silver bolt against the silver nut gave the best results of the metallic coatings, with an average release torque of 196.4 inch-pounds. The same test specimens were cycled the sixth time but, before being released, the nuts were saturated with penetrating oil and allowed to set 10 minutes. The aver-



Bolt that was wrung in two by nut freezing. Note how locking feature has deformed two threads and sheared off the third. X 10.



Bolt "as received" from stores. Note flaky oxide on surface. X 10.

age release torque was 162. Four of the eight nuts and bolts were degreased and the penetrating oil was allowed to remain on the other four sets of nuts and bolts. The eight sets were subjected to another heat cycle and on cooling all eight were again soaked with penetrating oil. The average release torque of all eight was 155 inch-pounds. The degreased four averaged 10 inch-pounds less, the undegreased averaged 5 inch pounds less. This was not considered significant, particularly on the basis of such a small sample.

Some investigation was made into the reason for wringing-off of bolts in some cases. Examination of the nuts and bolts at high magnification revealed that the surface finish of the threads of the nuts was very poor. Large burrs at the ends of the locking feature slots extended high above the top of the thread. These acted as gouges which plowed up and accumulated detritus in the threads. Other nuts had slivers of metal extending out from the threads. These slivers or burrs would break off and jam into the threads of the bolts or shear off pieces of the bolt thread. Several nuts that were plated with platinum and rhodium and nickel (on bronze bolts) had jammed, causing the bolt to shear off. The nuts were cut from the bolt with a hack saw. It was found that the locking feature had completely removed one thread and severely deformed the others.

All bolts that were received from stores were covered with a flaky oxide. It was necessary to remove this oxide with an acid pickle before plating the bolts. All bolts tested without plating were first pickled.

It was noted on the series with the graphite-resin film A. and silver nuts, number 4 specimen consistently had a lower seating torque and release torque and lower running torque. Measurements showed that the P.D. of all the bolts were almost identical but No. 4 nut would take both the go and no go ends of a $\frac{1}{4}$-28 NF 2 gage. The tighter nuts with higher torques would not take the larger end of the gage.

Plating Process

All bolts were pickled in a nitric-hydrofluoric acid solution (20%-20%) at room temperature and then vapor blasted. Racked for plating, they were treated anodically in a Wood's nickel strike bath then given a nickel strike cathodically, rinsed and plated with the metal under test. Bronze, nickel, and silver were plated to a depth of 0.3 mil. The platinum and rhodium were 0.1 mil.

All nuts used in the tests were received silver plated by the vendor. The silver plate was stripped with nitric acid and replated with the desired metal. It should be noted, therefore, that the nuts were manufactured with a tolerance to allow for 0.3 mil plate. The bolts were not made with this tolerance. If the pitch diameter of the bolt were reduced to allow for this plate the release torques would be less for the plated bolt.

Recommendations

The actions listed below will all, in some measure, help lower the release torque and, in some cases, the results of several will be cumulative.

1. Improve finish on threads of nuts.
2. Remove oxides from bare bolts.
3. Silver plate the bolts as well as the nuts.
4. Reduce pitch diameter of bolt to accommodate silver plating.
5. Use graphite suspension on bolts.
6. Use graphite-resin film on bolts.
7. Use penetrating oil on bolts and nuts just prior to releasing torque.

SHOP PROBLEMS

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gladly received and the sender's name will be kept confidential, if desired.

Copper Mirrors

Question: A so-called "Myers Process" has been reported to us for applying copper films to glass. Can you refer us to a source of information on this process or to a supplier who can provide us with details and solutions?

E. L. W.

Answer: The Myers process consists of sensitizing the surface with a tin chloride solution, followed by a gold chloride solution. The copper film is then produced from a copper salt solution and a reducer, in a manner similar to the production of silver mirrors on glass. The solutions are as follows:

Tin Sensitizer:

Tin chloride	180 g.
Hydrochloric acid	180 cc.
Water	200 cc.

Apply for 3-5 minutes and rinse.

Gold Sensitizer:

Gold chloride	2 grams
Water	50 cc.

Use 10 cc. of this solution per gallon of water and immerse for 5 minutes. Do not rinse.

Copper Solution:

Copper sulfate	53 grams/gal.
Nickel chloride	16 "
Formaldehyde	200 cc./gal.

Reducer:

Caustic soda	40 grams/gal.
Rochelle salt	173 "
Soda ash	16 "

Mix equal parts of copper solution and reducer and apply at room temperature. After 20-25 minutes rinse off and dry. The reducer is alkaline and should be kept in a polyethylene bottle.

Conductor Current Capacity

Question: I have been reading the information in the METAL FINISHING GUIDEBOOK on racks, which shows the maximum practical amperage for various rack metals. I am fully aware that materials have different resistivity ratings but I am at a loss to understand how some of these figures are calculated. For example, a one-inch round brass bar is listed at 157 amps.

F. G. J.

Answer: All rack and bus bar calculations are based on a capacity of 1,000 amperes per square inch cross section of copper. The maximum voltage drop at room temperature is about 0.0082 volt per running foot. This rating is used only for convenience and, if a larger voltage drop is permissible, larger currents can be carried, limited only by the heat developed in the conductor.

Brass has a conductivity only one-fifth that of copper, so that a 1" cross-section will be rated at 200 amperes. Since a 1" round brass bar has a cross-sectional area of 0.786 sq. in. it is rated at $0.786 \times 200 = 157$ amperes.

Nickel Stripping Cost

Question: Over the course of many years I have collected some figures on costs of various finishing operations. However, I have never seen anything on the cost of stripping nickel plate. Our shop does an appreciable amount of replating and such figures would be of special interest to me.

L. R.

Answer: There is no general figure on stripping cost since it will vary with the size and complexity of the piece, the deposit thickness, and the stripping method. Proprietary strips will cost about 25-30 cents per square foot per mil thickness. The anodic sulfuric acid strip is slightly cheaper but requires racking and unracking so that the overall cost will be about the same. The non-electrolytic stripping processes, of course, do not require an investment in generating equipment.

Yellow Brown Color on Steel

Question: We are enclosing sample torsion springs and a few bronzed fish hooks, the fish hooks being the finish we are trying to apply to our torsion springs. We have approached numerous plating, lacquer, and varnish companies without success, and now believe that this gold bronze finish is achieved by a chemical dip process.

Any information relative to our problem would be greatly appreciated.

J. F.

Answer: The fish hooks appear to be temper-colored, by heating to about 490°F. A yellow-colored, thin wax or lacquer film also appears to have been applied.

Silver in Copper Bath

Question: I have been a subscriber to METAL FINISHING for a good many years, but this is the first time that I've had the occasion to write to you, and ask a few questions concerning the accumulation of silver in a Rochelle salt copper plating bath.

What effect has the Ag on the Cu deposit? What would cause the anode to become coated with Ag and then flake off and lie in suspension in the bath? Would Ag in the Cu anode cause this?

I am trying to determine how Ag would build up, other than carry-over from the Ag bath or silver rinse tanks. Any other information concerning this subject would be appreciated.

What is the simplest way of removing this Ag from the Cu bath?

F. M. L.

Answer: A minute amount of silver in a Rochelle copper solution will result in a bronze-colored deposit. Significant amounts will result in blistering of the deposit.

Unless the copper anode has been cast from impure scrap, there should be no silver present from this source. If the deposit which forms on the anode in sufficient amount to flake off is really silver, it would indicate the presence of an extraordinary amount of contamination. This would be more

likely from addition of silver cyanide to the tank by mistake, instead of copper cyanide, rather than from drag-in.

If copper-plated sheets of steel are hung in the tank overnight, and the anodes removed, the silver will deposit out on the sheets, a simple method of removal.

Calculating Silver and Gold Costs

Question: I would like your cooperation to calculate the cost for plating silver and gold, per square foot — the best method available.

K. W.

Answer: One ampere will deposit in one hour 0.13 tr. oz. silver, costing about 13 cents, or 0.24 tr. oz. gold, costing about $10, at 100% cathode efficiency. Therefore, if a good ammeter and timer are employed, or an ampere-hour meter, the cost of the metal deposited on the load can be calculated from the above. Dividing the total cost by the number of square feet of surface or the number of pieces will give the unit cost.

Silver will deposit at about 100% efficiency, but the efficiency of gold baths will vary very widely, depending on the type of solution and the operating conditions. A test will be required for the latter metal, from which efficiency can be calculated, and a suitable correction made.

Caustic Black on Iron

Question: We operate a blueing tank 24" x 36" x 14" containing:

Caustic soda	210 lbs.
Sodium nitrite	57 "
Sodium nitrate	57 "
Temperature	140°C.
Time	30 minutes

I have noticed at times that the metal has a rust-red color when it comes out of the tank. It can be rubbed off but I would like to know what should be done to correct the rust color and do away with the rubbing? Does this color indicate that sodium nitrate and sodium nitrite should be added? What part do these chemicals play in the solution?

A. M.

Answer: The red discoloration is due to iron accumulating in the solution. A number of additions have been patented, which will sequester the iron and eliminate the problem. These are incorporated in most proprietary salts on the market today. Some suppliers furnish the material separately, and you can write to companies listed in the METAL FINISHING GUIDEBOOK-DIRECTORY under "Blackening Processes."

The nitrate-nitrite mixture is the oxidizing agent, necessary in the caustic soda bath in order to form the film, which is iron oxide.

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Patents

RECENTLY GRANTED PATENTS IN THE METAL FINISHING FIELD

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Conversion Coating — Phosphate

U. S. Patent 2,979,430. *April* 11, 1961. *H. Keller, R. Brodt and K. Lampatzer, assignors to Parker Rust Proof Co.*

A method of forming heat resistant coatings on a surface of ferrous metal and alloys thereof comprising contacting said surface with a solution containing as the essential coating producing ingredients between about 70 grams PO_4 per liter and 400 grams PO_4 per liter of calcium monophosphate, an amount of phosphoric acid sufficient to prevent the formation of a precipitate from the said monophosphate in said solution, and up to 50% based on said monophosphate of a thermally decomposable phosphate selected from the group consisting of ammonium phosphate, urea phosphate and aniline phosphate, said thermally decomposable phosphate being present in concentrations always less than 115 grams PO_4 per liter, and thereafter subjecting said surface to temperatures between about 300°C. to 1,200°C. for a period of time sufficient to yield a firmly adherent phosphate coating on said surface.

Crankshaft Plating Rack

U. S. Patent 2,979,452. *April* 11, 1961. *R. E. Ludwig and D. D. Dalrymple, assignors to National Forge Co.*

Apparatus for electroplating a crankshaft journal.

Roller Coater

U. S. Patent 2,980,057. *April* 18, 1961. *C. F. Brown, Jr., and R. G. Corbin, assignors to John R. Wald Co., Inc.*

In a device for coating flat ferrous metal articles, means for conveying said metal articles to a coating station, magnet means underlying said conveying means and being adapted to draw said metal articles into firm contact with said conveying means during the coating operation, said magnet means including a pair of pole faces that extend substantially the length of said conveying means and means for coating said metal articles, said coating means including coating rollers disposed above said conveying means and contacting said metal articles as they are conveyed thereunder, said coating rollers transferring coating material onto said metal articles at said coating station.

Electrostatic Spraying

U. S. Patent 2,980,337-8. *Apr.* 18, 1961. *J. Kozinski, assignor to H. G. Fischer & Co.*

Electrostatic type paint spray system of the spinning disc type.

Pickling of Magnesium Alloys

U. S. Patent 2,980,559. *April* 18, 1961. *L. Whitby, assignor to The Dow Chemical Co.*

The method of removing contaminants from the surface of a magnesium article which comprises subjecting the article to the action of an aqueous solution consisting by weight of between 10 and 40 per cent of glycolic acid and from ⅓ to 1/10 as much of NO_3, in the form of a soluble nitrate selected from the group consisting of ammonium and alkali and alkaline earth metal nitrates, as the weight of glycolic acid in said solution.

Hot Paint Spraying

U. S. Patent 2,980,339. *April* 18, 1961. *H. F. Bok and E. Bok.*

A paint spraying apparatus comprising a paint supply source, a spray gun and an evaporating device interconnecting said supply source and said spray gun, said evaporating device having mounted therein a heating element for the formation of a spraying medium by the evaporation of a volatile liquid and a heat exchanger through which said paint is conveyed.

Bright Nickel Plating

U. S. Patent 2,980,595. *April* 18, 1961. *M. K. Sanicky, assignor to Incar, Inc.*

A bright nickel plating bath containing a primary brightener of the first class selected from the group consisting of aryl sulfonamides, aryl sulfinimides, aryl sulfinic acids and arylsulfone sulfonates, and from about 0.001 to 0.1 gram per liter of a totally hydroxyalkylated alkylene polyamine having 3 to 5 nitrogen atoms as a booster.

Drying Attachment for Spray Gun

U. S. Patent 2,980,786. *April* 18, 1961. *R. C. Chilton.*

A drying device for association with the nozzle of a spray gun or the like, comprising an annular hollow housing having means to attach the same to said gun with said housing disposed coaxially and forwardly of said nozzle and out of direct heat transfer relation thereto, an annular heating element within said housing to heat the interior thereof, and means to supply air under pressure to said interior to be heated by said heating element, said housing being provided with air jet orifice means disposed to discharge the heated air into a spray discharged by the nozzle.

Cutter Head for Plating Racks

U. S. Patent 2,980,986. *April* 25, 1961. *S. Gryglas.*

A cutter head comprising a socket portion open at one end and having a wall at the other end and an axial stem projecting from the wall, an annular series of combination blade holder and separator members mounted in said socket portion, retainer means connected to said portion and securing said members within said portion between the same and said wall, each member having a radially extending trailing side and a leading side generally parallel to and opposing the trailing side of the adjacent member and circumferentially spaced therefrom, a shoulder on the radially inner end of each member projecting circumferentially thereof from said trailing face toward the adjacent member and having an outwardly facing seat, blades interposed between said members in engagement with the trailing and leading faces thereof and having inner edges partially seated upon the seat and having an edge projecting outwardly from the seat into a central sizing opening, each member having a segmental conical forward face, said conical faces collectively defining a cavity for admitting a work-piece therein, said blades having forward diagonal sides converging toward said sizing opening and having radial cutting edges projecting for-

wardly of said faces, said forward sides sloping circumferentially from said radial edges toward respective conical faces and merging thereinto.

Roller Coater Machine

U. S. Patent 2,981,226. *April* 25, 1961. *E. E. Murray*

In liquid coating apparatus, a rotatable applicator roll, a doctor member mounted adjacent said roll so as to form therebetween a cavity adapted to contain a pool of liquid coating material, said doctor member having an upper overflow edge defining the upper limit of said pool, and means adjustably mounting said doctor member in said apparatus so that the position of said edge is vertically adjustable to adjust the size of said pool.

Apparatus for Handling Overspray Paint

U. S. Patent 2,981,525. *April* 25, 1961. *E. Umbricht, assignor to Ajem Laboratories, Inc.*

A spray booth for collecting and handling overspray paint materials in which recirculating liquid media is arranged to capture, kill, and float in fluidized form the overspray paint materials, apparatus for handling the liquid substrate and selectively removing the upper portion thereof.

Pickling Method

U. S. Patent 2,981,633-4. *April* 25, 1961. *S. C. Davis and W. G. Ray, assignors to Chas. Pfizer & Co., Inc.*

A process for the porcelain enameling of ferrous metal objects comprising the steps of cleaning the ferrous metal, then pickling with an aqueous solution of citric acid containing from about 5% to about 20% by weight of acid at a temperature of from about 160° to about 212°F. for from about 5 to about 30 minutes, then depositing nickel on the surface in an amount of from about 0.03 to about 0.15 gram per square foot, then coating the object with porcelain enamel, drying at from about 250 to about 400°F. and baking same at from about 1300° to about 1550°F. for from about 3 to about 6 minutes.

Pickling Stainless Steel

U. S. Patent 2,981,643. *April* 25, 1961. *R. D. Baybarz, assignor to the United States of America*

A process for removing oxides from the surface of stainless steel which comprises contacting the metal in an atmosphere inert to chromous sulfate with a dilute aqueous sulfuric acid solution containing chromous sulfate.

Hot Dip Aluminum

U. S. Patent 2,982,015. *May* 2, 1961. *J. B. Russell, assignor to Kaiser Aluminum & Chemical Corp.*

A composite article comprising a base portion of ferrous metal hot dip coated with an aluminum base alloy of improved wettability to the ferrous base consisting essentially of chromium in amount from about 0.1 to 0.4%, and at least one of the elements molybdenum and tungsten in amount from about 0.1 to 0.4%, the total amount of these alloying constituents not exceeding about 0.5%, the balance substantially all aluminum and impurities in normal amounts.

Gas Plating

U. S. Patent 2,982,016. *May* 2, 1961. *F. E. Drummond, assignor to Union Carbide Corp.*

A method of providing a metal body with an outer shell or layer of aluminum and magnesium metal which comprises the steps of cleaning the surface of the metal body, heating the resultant cleaned metal body in a dry, inert atmosphere and thereafter subjecting said heated metal body while retained in said atmosphere to a gaseous mixture composed of the metal alkyls aluminum triethyl and magnesium diethyl, and maintaining the temperature high enough to cause decomposition of the aluminum and magnesium alkyls and deposition of aluminum metal and magnesium metal onto said metal body and into the pores and interstices thereof.

Ultrasonic Cleaning

U. S. Patent 2,982,524. *May* 2, 1961. *M. R. Bland, assignor to Purex Corp.*

Ultrasonic cleaning equipment, comprising a receptacle forming an interior zone for receiving a body of liquid and parts to be cleaned therein, rotary means axially rotatable in the liquid received in said receptacle for flowing the liquid therein, and wedge means carried by said rotary means at a radially outward location relative thereto for high velocity rotary displacement in said liquid in the direction of wedge taper relatively to accelerate liquid over the wedge producing ultrasonic disturbances propagating in said liquid body through said zone as the wedge is rotated in said liquid.

Pickling Waste Recovery

U. S. Patent 2,982,615. *May* 2, 1961. *B. H. McMullen and R. D. Toomey, assignors to National Lead Co.*

A process for treating waste H_2SO_4 liquor containing trivalent alum-forming cations and solubilized metallic impurities including iron, magnesium and titanium values to obtain a substantially solids-free acid concentrate comprising the steps of: adding to said waste acid liquor a monovalent alum-forming constitutent selected from the group consisting of compounds of ammonium and potassium to precipitate an alum salt together with said metallic impurities in the form of a crystalline mass upon cooling said waste acid liquor, removing heat from said waste acid liquor to cool the latter to a temperature within the range of from —26°C. to —47°C. thereby forming a crystalline mass of said alum salt and said metallic impurities, filtering the waste acid liquor to separate and remove said mass of crystalline salt and produce a residual acid filtrate substantially free of alum-forming cations and metallic impurities, adjusting the acid concentration of said residual acid filtrate to within the range of from 23% to 33% H_2SO_4 in accordance with the temperature of said acid filtrate, the higher acid concentration being used with the higher temperatures and the lower acid concentrations with the lower temperatures such that any residual iron, magnesium and titanium values in said residual acid filtrate are within the molar ratio range ($FeSO_4 + MgSO_4$) to $TiOSO_4$ of from 0.8 to 1.25, concentrating said acid filtrate to at least 80% H_2SO_4 thereby precipitating the residual iron, magnesium and titanium values from said concentrated acid filtrate as an insoluble complex salt and then filtering said concentrated acid filtrate to separate said complex salt therefrom and produce a solids-free acid concentrate.

Plating on Uranium

U. S. Patent 2.982.702. *May* 2, 1961. *R. F. Wehrmann, assignor to the United States of America*

A process for pretreating uranium for metal plating, comprising anodically treating a uranium article at a current density of from 60 to 100 amperes/ft.^{2} in an aqueous solution of about 10%

polycarboxylic acid, from 1 to 5% by weight of glycerine and from 1 to 5% by weight of hydrochloric acid for from 30 seconds to 15 minutes, said solution having a temperature of from 20° to 75°C.

Copper Etch

U. S. Patent 2,982,625. *May* 2, 1961. *E. B. Saubestre, assignor to Sylvania Electric Products Inc.*

An improved etchant for copper and copper alloys consisting of a mixture of chromic and sulfuric acids containing peroxysulfate ions.

Hot Dip Coating Unit

Reissue U. S. Patent 24,985. *May* 9, 1961. *R. F. Renkin, assignor to Sharon Steel Corp.*

An apparatus for continuously hot coating metal strip selectively with different coating metals.

Centrifugal Abrasive Blasting

U. S. Patent 2,983,082. *May* 9, 1961. *C. M. Gossard, assignor to Pangborn Corp.*

An abrasive throwing wheel comprising a runner head mounted for rotation around a hub which includes a feed cage, an impeller in said feed cage rotatable with said runner head, means to feed abrasive particles into said cage, an opening in the peripheral surface of said cage, a plurality of throwing vanes mounted on one face of said runner head and rotatable around said cage, and each of said vanes having a blade provided with a throwing surface upon which is formed a rib device.

Barrel Finishing Machine

U. S. Patent 2,983,084. *May* 9, 1961. *R. T. Romine, assignor to Bell Intercontinental Corp.*

A barrel finishing machine comprising in combination a rigid base frame having laterally spaced apart, vertically disposed, end frame members, a horizontally disposed barrel mounted for rotational movement about a horizontally disposed axis within said base frame members and supported on said end frame members.

Platinum Bath

U. S. Patent 2,984,603. *May* 16, 1961. *R. Duva and E. C. Rinker, assignors to Sel-Rex Corp.*

As an electrolyte for plating of platinum, a solution comprising water and the solution obtained by heating 10-40 g. of platinum diamino dinitrite in about 200 cc. of an aqueous mixture containing about 10-100 cc. of concentrated sulfuric acid and 10-100 cc. of concentrated phosphoric acid.

Continuous Vacuum Metalizing

U. S. Patent 2,983,249. *May* 9, 1961. *C. A. Baer, P. J. Clough and J. H. Gardner, assignors to National Steel Corp.*

In apparatus for coating a substrate under vacuum which includes a vacuum chamber containing a source of coating vapors and a plurality of vacuum chambers through which the substrate is passed from atmosphere to the coating chamber, the improvement which comprises a passage of adequate length between two of said chambers, a portion of the passage being filled with a sufficient mass of particulate solid material to effectively impede flow of gases between said chambers at pressures of less than 50 mm. Hg abs.

Plating on Magnesium

U. S. Patent 2,983,634. *May* 9, 1961. *P. Budininkas, assignor to General American Transportation Corp.*

The process of plating with nickel on metal surface formed essentially of magnesium, comprising cleaning, then treating with a first aqueous solution of a passivating agent selected from the class consisting of chromic acid and orthophosphoric acid in order to form a protective film thereupon to prevent corrosive attack thereof by water, then treating with a second aqueous solution of a fluoride in order to form a fluoride film, then treating with a third aqueous solution of a pyrophosphate in order to form a phosphate film, and then contacting said metal surface with an aqueous chemical nickel plating bath of the nickel cation-hypophosphite anion type also containing a citrate and a fluoride.

Cooling of Chromium Plating Solution

U. S. Patent 2,984,081. *May* 16, 1961. *E. A. Hahn, assignor to Lyon Inc.*

A method of equalizing the temperature of a plating bath having relatively warm aqueous plating solution therein, which includes the steps of passing the relatively warm solution into an evaporation zone and removing heat from said solution by boiling while generating vapors therefrom to substantially reduce the temperature of the solution, passing the reduced temperature solution directly into the plating bath at essentially the temperature resulting from the heat removal in the evaporation zone, removing the vapors from the evaporation zone and directing said vapors into a condensation zone, and removing the condensate from the latter zone and receiving the same in a collection zone.

Conversion Coating - Phosphate

U. S. Patent 2,984,592. *May* 16, 1961. *J. E. Logan, assignor to Chem-Metals, Inc.*

In the process of producing a protective coating on a galvanized sheet which will reduce and greatly delay the formation of white oxide products between sheets when wet, the steps comprising applying to the surface of a sheet emerging from a galvanizing bath while the sheet is at a temperature of at least 400°F., a thin film of an acid solution consisting essentially of at least one acid from the group consisting of orthophosphoric acid, metaphosphoric acid and pyrophosphoric acid, the concentration of acid in the solution providing phosphorus oxide at a concentration equivalent to that of .2% to 35% orthophosphoric acid, the applied film depositing the equivalent of from $\frac{1}{8}$ to 10 pounds of H_3PO_4 per 10,000 square feet of surface, the heat of the sheets evaporating in a few seconds the solvent from the applied thin film of the acid solution effecting a highly protective phosphate reaction product on the sheet surface which product is not visually observable.

Printed Circuit Manufacturer

U. S. Patent 2,984,595. *May* 16, 1961. *K. Schumpelt and A. Korbelak, assignors to Sel-Rex Precious Metals, Inc.*

In the preparation of printed circuits by the process comprising electroforming at least one circuit element on the exposed area of a stainless steel base member with insulating coating material on other surface portions thereof and, thereafter, transferring and embedding the circuit element in the surface region of a plastic insulating base member, the improvement comprising first plating the exposed areas of the stainless steel base member with a layer of palladium from an ammoniacal bath to a thickness of about 1×10^{-6} to 10×10^{-6} inch, and thereafter plating at least one additional layer of metal over the palladium layer whereby a ready separation

(*Continued on page* 74)

Science for Electroplaters

67. Bright Nickel

By L. Serota

AN important consideration in the use of electrodeposited nickel coatings for decorative purposes, in addition to ability to protect steel, brass, and zinc-base die castings from corrosion, is the property of the metal of imparting a bright finish under suitable plating conditions, when thin films of chromium or the precious metals are plated over a bright nickel surface.

The interest in, and development of, bright nickel plating, which has become pronounced since about 1935, stems from the fact that the buffing operation necessary for obtaining a high luster could entail a costly labor operation.

Bright nickel deposits, E. B. Saubestre indicates, are achieved by the following methods: organic bright nickel baths; leveling nickel baths; nickel alloy baths; PR plating; electropolishing.

Fig. 1. Typical nickel electrodeposition pattern formed on copper single crystals in a Watts type bath. View normal to (111).

Orientation

W. Smith, J. H. Keeler and H. J. Read note that the relative brightness of electrodeposited metals (nickel) is associated with variations in current density, temperature, pH, chloride concentration, thickness of deposit, basis metal orientation, and the interrelationship of such variables. H. J. Read and R. Weil indicate that the association of brightness with grain size and hardness is often mentioned in literature.

A view previously expressed by a number of investigators referred to the fact that brightness results from preferred orientation (fibering). W. A. Wood, for example, in his study of electrodeposited nickel by X-ray diffraction examination, reported that brightness was found to be associated with the degree of selective orientation of the metal grains, and hardness with the degree of diffusion of the X-ray diffraction spectra. Orientation, Wood reported, was greater at the low current densities. However, no consistent relationship was found in this investigation between changes in degree of orientation and changes in hardness of the metal. A high degree of orientation of the deposit was obtained with copper.

L. Palatnik found, similarly, in his X-ray studies of cadmium and zinc electrodeposits, that brightness increased with the degree of orientation of crystals, and that the degree of orientation of crystals depended upon the concentration of colloids (dextrin, sulfonated castor oil) in the bath.

Although preferred orientation appears to be an important factor for brightness, W. Blum, R. O. Beckman and W. R. Meyer did not consider preferred orientation the only criterion for brightness of deposits since data, they contend, were not available for correlating crystal size and degree of orientation. They suggested that brightening agents, as for example metals, are codeposited and in that manner encourage preferred orientation, thereby controlling brightness.

H. Leidheiser Jr. and A. T. Givatmey obtained evidence of preferred orientation in bright plating of metals when nickel was electrodeposited on polished single crystal spheres of copper and nickel from a simple Watt's bath. A mirror-bright, smooth deposit was formed on the "100" faces up to thicknesses of 0.01 inch. Deposits on the

Table I. Plating Conditions and Brighteners.

Panel	Addition Agent
NAX	None
A-2	0.2 g/l saccharin
A-4	0.4 g/l saccharin
A-6	0.6 g/l saccharin
B-2	0.2 g/l 1–5, naphthalene disulfonic acid
B-4	0.4 g/l 1–5, naphthalene disulfonic acid
B-6	0.6 g/l 1–5, naphthalene disulfonic acid
B-8	0.8 g/l 1–5, naphthalene disulfonic acid
B-10	1.0 g/l 1–5, naphthalene disulfonic acid
C-2	0.2 g/l p-toluene sulfonamide
C-4	0.4 g/l p-toluene sulfonamide
C-6	0.6 g/l p-toluene sulfonamide
C-8	0.8 g/l p-toluene sulfonamide
C-10	1.0 g/l p-toluene sulfonamide
D-2	0.2 g/l m-benzene disulfonic acid
D-4	0.4 g/l m-benzene disulfonic acid
D-6	0.6 g/l m-benzene disulfonic acid
E-2	0.2 g/l 2–7, naphthalene disulfonic acid
E-4	0.4 g/l 2–7, naphthalene disulfonic acid
E-6	0.6 g/l 2–7, naphthalene disulfonic acid
E-10	1.0 g/l 2–7, naphthalene disulfonic acid
F-1	1.0 g/l Zn plus 0.6 g/l 1–5, naphthalene disulfonic acid
F-2	1.0 g/l Zn plus 1.0 g/l 1–5, naphthalene disulfonic acid
H-1	0.2 g/l chloral hydrate plus 0.6 g/l 1–5, naphthalene disulfonic acid
H-2	0.2 g/l chloral hydrate plus 1.0 g/l 1–5, naphthalene disulfonic acid
H-3	0.6 g/l chloral hydrate plus 1.0 g/l 1–5, naphthalene disulfonic acid
K-1	2.5 g/l formaldehyde plus 0.6 g/l 1–5, naphthalene disulfonic acid
K-2	2.5 g l formaldehyde plus 1.0 g/l 1–5, naphthalene disulfonic acid
L-1	15.0 g/l Ni-formate plus 0.6 g/l p-toluene sulfonamide
L-2	30.0 g/l Ni-formate plus 0.6 g/l p-toluene sulfonamide
N-1	0.2 g/l chloral hydrate plus 0.6 g/l p-toluene sulfonamide
N-2	0.6 g/l chloral hydrate plus 0.6 g/l p-toluene sulfonamide
O	2.5 g/l formaldehyde plus 0.6 g/l p-toluene sulfonamide

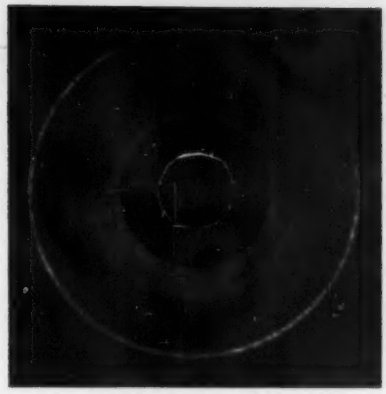

Fig. 2. Specimen NAX.

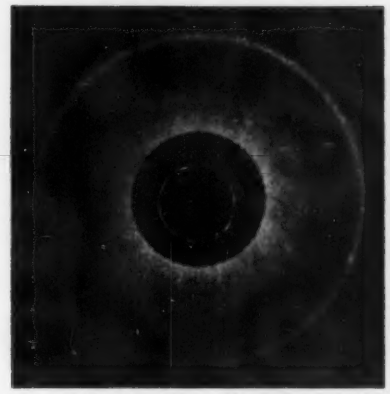

Fig. 3. Specimen H2, typical pattern of a bright nickel plate showing line densities similar to NAX (dull nickel).

"111" faces became mat. Whereas, the deposit on the "100" face remained mono-crystalline, the polycrystalline condition of the deposit on the "111" face, they found, assumed, rapidly, a "100" preferred orientation. Fig. 1 is a photograph of electrodeposited nickel on copper single crystals from a Watts-type bath. The dark "100" areas are explained by the smoothness of the surface, which reflects little light into the camera lens, whereas the light areas (111) are microscopically rough, hence reflect a good deal of diffused light into the camera.

A significant observation made of these results refers to the fact that deposits in the "100" area were bright only if deposition occurred on a bright nickel or copper substrate so that "100" areas etched or roughened prior to plating did not show increased brightness with thicker deposits. The suggestion is therefore advanced that the mechanism of brightness, when plating with addition agents, differs from that observed on the "100" face. The differences in plating characteristics of the "100" and "111" faces are associated by the authors with differences in initial current density or average current density on the two faces in the plating operation.

W. Smith, J. H. Keeler and H. J. Read, on the other hand, found no overall relation between preferred orientation and brightness in electrodeposited nickel. In their investigation the only variable was the agent added to influence brightness. Their conclusion is based upon a large number of specimens investigated. The purified bath contained 42 oz./gal. $NiSO_4 \cdot 6H_2O$; 6 oz./gal. $NiCl_2 \cdot 6H_2O$; 6 oz./gal. H_3BO_3. The solution was operated at a pH of 4.0, at 140°F., current density of 50 amp./ft.^{2}, with the thickness of the deposit 0.0025 inch. Electropolished hot-rolled bumper stock (free of preferred orientation) was used to avoid orienting effects. The list of addition agents and the concentrations used is shown in Table I.

Crystal structure of the plated nickel was determined by the back reflection method of X-ray analysis. The degree of fibering (preferred orientation) was obtained by a comparison of ratios of intensity of lines on X-ray patterns, using a densitometer. Reciprocals of values obtained were recorded as the line densities. Visual estimations of line intensities were also made. An indication of similarity in line densities obtained by this X-ray method is strikingly demonstrated (Fig. 2) by the line patterns for a dull nickel NAX specimen (Table I) plated from a bath without a brightener and the pattern for a specimen, H 2, of a bright nickel plate (Fig. 3).

A comparison of degree of fibering to brightness of the plate required a measuring device for recording the relative brightness of the plated specimen. Brightness evaluated by visual means was considered sufficient in this investigation.

In Fig. 4, a graphical account of the relationship between the degree of preferred orientation and brightness (eye evaluation) of the deposit indicates, the authors note, that there is no correlation between fibering and brightness. They found that only six of thirty-three specimens tested showed more preferred orientation (densitometer measurements) than the dull specimen, NAX, with no brightener. The eye-evaluation of the X-ray patterns showed eight specimens with higher degree of fibering.

Mention is made of the fact that the data for brightness obtained by the reflectometer, when compared to the visual method, showed discrepancies; a result which lends support to the

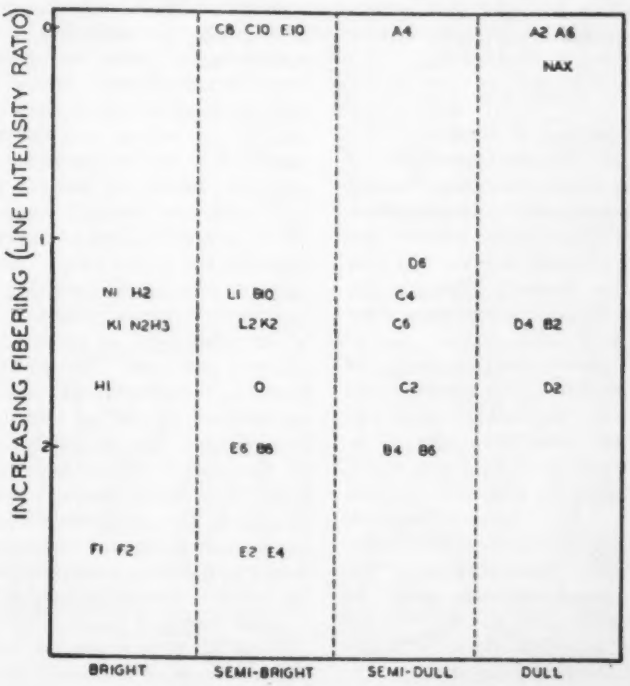

Fig. 4. Graphical representation of the relationship found between degree of fibering (preferred orientation) and brightness of the plate as measured by the eye. The very poor correlation is easily seen.

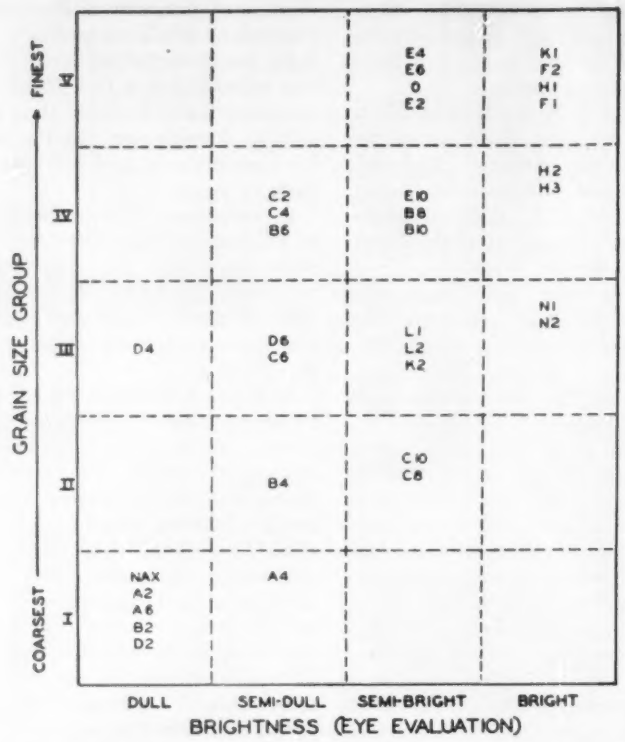

Fig. 5. Relationship between grain size and brightness of electrodeposited nickel.

view expressed that brightness of a surface cannot be determined by a simple system. However, it is emphasized that useful comparisons may be made.

Grain Size

H. J. Read and R. Weil, in a continuation of this study involving investigation of the relationship between brightness and grain size and hardness, found no correlation between the brightness of nickel deposits and their grain size or hardness. Plating conditions and brighteners used were those indicated in Table I.

A questionable phase in the use of the X-ray method for the determination of grain size, the authors note, pertains in the blind spot area, 5×10^{-4} mm and 2×10^{-4} mm, where X-ray patterns are insensitive to grain size. Because this region corresponds to the critical area for bright and semi-bright nickel deposits, recourse was had to optical methods, since the geometry of the grain structure was not conducive to single linear measurements representing grain size.

By this procedure (eye evaluation), grain size distribution was accomplished satisfactorily by arranging the specimens investigated into five groups, with group I representing the coarsest grain size and group V the finest.

The distribution referring to this relationship of brightness, by eye evaluation, to grain size groups of plated nickels is shown in Fig. 5. The data on the chart, the authors emphasize, do not indicate any well defined relationship, since a given brightness group is distributed between two to four brightness classes. Thus, group III, it will be observed, encompasses virtually the entire range, from the dull D4 type to N1 and N2, representing the brightest panels.

The relationship of preferred orientation to grain size, when plotted, was found to indicate broadly a decrease in preferred orientation with decrease in grain size. The general appearance of the plotted graph, however, was found to compare favorably with that of Fig. 5. The grain size corresponding to each group and represented by a typical specimen is demonstrated by the excellent photomicrographs, Fig. 6. A small section of the steel basis metal is included in each photomicrograph. The thickness of the nickel deposit is about 0.0015 inch.

Hardness

The hardness measurements were made with a Knoop indenter. When Knoop hardness numbers were plotted against brightness (eye evaluation) (Fig. 7), a general correlation was indicated. The graph reveals, for example, that the dull deposit specimen, D 4, was close in hardness to that of the brightest deposits, N 1 and N 2, and even in the bright range the hardness extended from 400 to 640. This would seem to indicate, the authors contend, that bright plates are not harder than those not so bright.

When hardness was plotted against grain size, the comparative study seemed to indicate that hardness increased as grain sizes decreased. The general conclusion arrived at, based upon these results, the authors indi-

Specimen A6. Typical of grain-size group I. 1000X.

Specimen C10. Typical of grain-size group II. 1000X.

Specimen N1. Typical of grain-size group III. 1000X.

Specimen C4. Typical of grain-size group IV. 1000X.

Specimen H1. Typical of grain-size group V. 1000X.

Fig. 6.

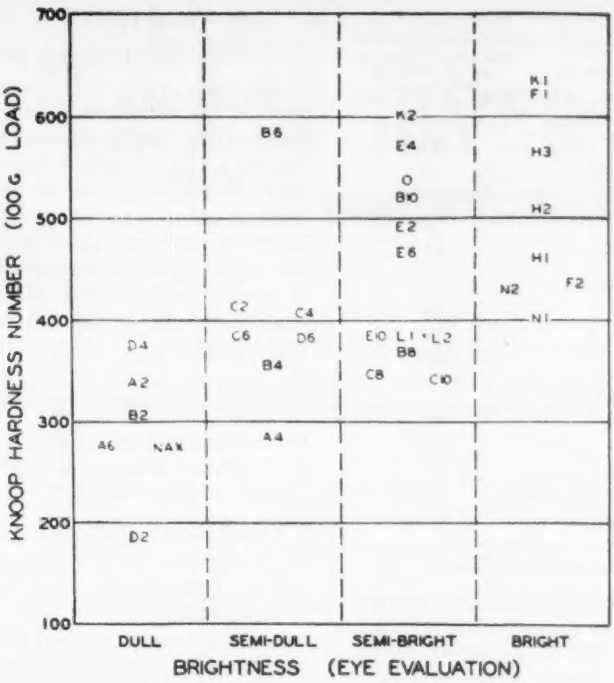

Fig. 7. Relationship between hardness and brightness of electrodeposited nickel.

cate, is that there is no correlation between the brightness of the plated nickel and the grain size or hardness.

In a recent study by R. Weil and R. Paquin, examination by electron microscope of nickel deposits of various brightness, plated from Watt's baths containing addition agents, added support to previously obtained results by others that there is no direct relationship between the degree of preferred orientation and grain size, and that preferred orientation is not proportional to grain. Although they found that the fiber axis was related to the structure, as platelet, equiaxed crystallite, or spiral type, no direct correlation was found for a given fiber axis. Structures, for example, consisting of large platelets, show coarse steps between the plates, indicating that bright deposits must be fine-grained.

Deposits with more than 99 per cent of the area having a roughness less than 0.15 μ showed an increasing brightness and decreasing grain size. It is emphasized, however, that small (fine) grain size is not a criterion for brightness. The number of test samples was not considered sufficient to establish a relationship between brightness and grain size.

Random Orientation

T. P. Hoare refers to the view held that, in bright plating, deposition of atoms is random rather than selective, a condition associated with co-deposits of foreign metal ions (some alloys) or oxides, adsorbed addition agents (the principal way), high current density, and high cathode polarization. In effect, any method tending to prevent or destroy formations favoring selective atom deposition will give a bright surface.

In considering the action of addition (organic) agents for brightening effects, by aiding random deposits, Hoare suggests two categories: the first group comprises molecules that rapidly adsorb and desorb in random manner, and the second group includes molecules that are not adsorbed as rapidly at sites which are more favorable for selective metal deposition.

Formaldehyde used in a bright nickel bath is cited as an example of the first type, that is, molecules possessing a high rate of adsorption and desorption. Included in this category, Hoare lists such molecules and ions, even though not considered basically addition agents, as ammonia, cyanide, fluoride, iodide ion, and some smaller complexing reagents, since they are known to adsorb on the metal surface (displacing water molecules from the metal surface), and the excess complex reagents in complex baths are generally considered favoring bright deposits.

The second group is represented by large complex organic molecules. It is emphasized, however, that this group may include some with a relatively rapid rate of adsorption and desorption, so that overlapping is possible. Gelatin, beta-naphthol, aryl-sulfonic acids are examples mentioned. This, in effect, indicates that a complimentary action is possible in the use of two addition agents.

Cathode Polarization

C. C. Roth and H. Leidheiser Jr., in investigating the effect upon cathode potential when various organic agents were added in different concentrations to a Watts-type bath, found that measurements for 76 organic compounds indicate that the compounds made the cathode potential more negative at a fixed current density. This was at-

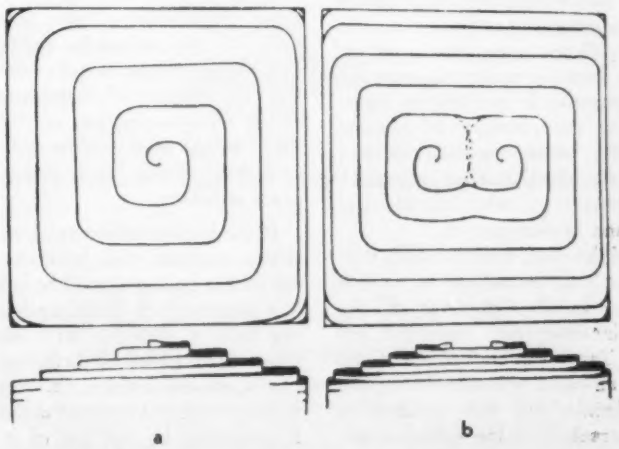

Fig. 8. Type of surface to be expected with deposition on (a) a single screw dislocation, and (b) a double screw dislocation.

TABLE II

Compound	Lowest conc. at which brightening was needed	Potential increase in mv for first sign brightening
	Very large compounds	
Polyamine 1200	0.000015 mole/l	23 mv
	Bicyclic compounds	
1—naphthylamine 4, 8, disulfonic acid	0.0006	16
Saccharin	0.0006	34
	Monocyclic compounds	
p-aminobenzonitrile	0.002	26
Bezenesulfonic acid	0.02	29
Pyridine	0.004	ca 88
	Short chain alkyl compounds	
Acrylonitrile	0.003	30
sym.-diethylthiourea	0.003	54
	Short chain	
Proprionitrile	0.003	45

tributed to such factors as the acid or basic character of the compound, the size of the molecule, the number of available pairs of electrons in the molecule — that is, electron pairs that may be shared with other atoms by association or chemical reaction without removing completely the original bond.

Compounds with a large number of available pairs of electrons contributed to increased cathode polarization. Chemical groups in such compounds have varying effects upon cathode polarization. The following list shows the decreasing order of effectiveness of such groups for increasing cathode polarization: nitrogen in conjugated bicyclic ring, nitrogen in conjugated monocyclic ring, nitrile, aldehyde; amino, nitro, tertiary amine, sulfane, sulfonyl-amide, sulfonate, carboxyl, ketone, and phenolic or alcoholic hydroxy.

Measurements of cathode potentials indicated that brightening occurred in most cases when the cathode potential was 20 to 50 mv more negative. Such change in cathode potential, with the over-all process, is ascribed to interference (in the presence of organic compounds) at the cathode surface. Those most effective were adsorbed, thereby interfering with the electron transfer and crystal growth.

Some of the compounds studied, with the lowest concentration at which brightening was first observed and the potential increase (mv) developed, are listed in Table II. One effect, noted in nearly all cases, was that the deposit became brittle and was inclined to peel and crack from the spherical surface at a cathode potential increase greater than 50 mv.

Dislocation Theory

A. M. Max associates brightness in deposits with imperfections or dislocations in the crystal structure. The dislocation theory, emphasized by C. C. Frank in its relation to crystal deposition, assumes that a normal deposit will show growth along screw dislocations. Thus, a dull appearance is, in effect, a step-type surface structure (Fig. 8) working down to a grain boundary and showing columnar crystals in cross section.

To produce bright deposits (improved surface appearance) refinement of crystal structure is indicated, either by the use of addition agents which tend to inhibit deposition of an ion, or by favorable operating (plating) conditions. One method suggested for attaining bright deposits of ions is to reduce the number of ions striking the surface Ns, so that the ratio Ns/Nr, relating to both the surface ions and those remaining in the lattice Nr (which is determined by current density) will approach one. Thus, the relative immobility of large molecules, which will concentrate in the dipole layer, would tend to slow diffusion of ions through this layer, giving a fine-grain structure.

If the lattice valleys exist, as in one lattice position, the bridging by an ion of this position could be compared, it is suggested, to a dislocation resulting from a vacancy. With additional layers, the effect of bridging would give a smooth surface. One result, the authors note, is a stressed deposit. This is overcome by the use of a second agent possessing the characteristic of plating compressively stressed nickel.

PATENTS

(*Continued from page 69*)

between the palladium layer and the stainless steel base is obtained and the exposed surface of each of the resulting circuit elements consists of corrosion resistant palladium when each of said circuit elements embedded in the surface region of the plastic base member is removed together with said plastic base member, from the stainless steel base member.

Printed Circuit Manufacture

U. S. Patent 2,984,597. *May* 16, 1961. *R. P. Hennes, assignor to Leighton R. Johnson, Jr.*

A method of manufacturing an electrical conductor of desired configuration on a permanent supporting base of insulating material, said method comprising steps as follows: providing a temporary support non-conductive material having a wax-treated side surface, applying to a waxed side of the temporary support a thin and fragile electrically conductive metallic coating, applying over a portion of the surface of the conductive coating a layer of non-conductive masking material that is resistant to electrolytic deposition and defines a negative representation of an electrical conductor of desired configuration, electrolytically depositing on the unmasked areas of the conductive metallic coating a layer of conductive metal to a thickness greater than that of the layer of masking material to provide on said conductive coating an electrical conductor main body of said predetermined configuration, placing the exposed surface of the conductor thus formed against and bonding it to a permanent supporting base of insulating material, and removing the temporary support from the permanent support while leaving on the permanent support the deposited main conductor body and those areas of the metallic coating on which said conductor body was deposited together with a protective coating of wax over the latter from the temporary support, the wax of the temporary support having thus protected the now outer surface of the metallic coating over the deposited conductor body against contamination and oxidation from the instant of application thereof to the temporary support and continuing such protection after removal of the temporary support.

LEA

ABRASIVE FINISHING METHODS

SILVER SOLID AND ALLOYS

STAMPINGS • SPINNINGS • CASTINGS

Of the noble metals silver is by far the most widely encountered in the metal finishing field. It is seldom used in the pure state but mainly in an alloy, such as sterling silver and, to a lesser degree, coin silver. As is commonly realized, the alloying elements, principally copper, are used to increase hardness and wear-resistance.

Because of the relatively high value of the metal, greater care is justified in devising the proper Lea Methods to see that metal losses in the finishing operations are kept to a minimum. The much higher price obtained for sterling silver articles justifies the greater finishing care.

Plated Silver, certainly an important subject, is discussed separately.

Following are the more widely used finishes for sterling and coin silver together with suggestions for producing them:

HAMMERED FINISH...Formerly, much silver was hammer-finished in order to refine the surface and because the alloys could be shaped readily by this method. The method is still used extensively, especially on reproductions. With hammering, of course, no silver is removed by abrasion.

DULL MATTE FINISH...With this finish, as well as with all the following finishes, the metal is first conditioned by "washing out" the pits by either spot sand bobbing or flexible polishing with **Grade "C" or Grade "B-31" Lea Compound** on leather or felt bobs. This step is usually followed by cut-down buffing with a Tripoli composition such as **Grade 765 Learok** and then by brushing at low speed with a suitable mixture of pumice and water.

DULL SATIN FINISH... Proceed as with the dull matte finishing up to but not through the pumice and water step. At that point, follow with a buffing step using **Grade "C" or Grade "B-31" Lea Compound,** whichever is better, at a speed of about 5000 sfm.

BUTLER FINISH, SEMI-BRIGHT TO BRIGHT...Follow the steps given under dull matte finish up to and including the **Grade 765 Learok** cut-down. Then proceed with the final finishing operations, using **Fine Silver grades of Lea Compound,** such as **Grades MH, B12 or 5023,** to give the desired butler finish. Full-disc or packed muslin buffs are used at 7000 to 7500 sfm.

SEMI-MIRROR FINISH...Proceed as with the dull matte finish, through the **Grade 765 Learok** cut-down step. Then follow with coloring, using either **Grade 302-C or Grade 884 Learok** on a loose muslin buff at 7500 sfm.

Where automatic buffing is being done **Grade TH52P Lea Liquabrade** is used for a cut-down operation and **Grade UH20A Liquabrade** for coloring.

MIRROR FINISH...Proceed as with the semi-mirror finish except use **Lea Red Rouge A100 Bar Compound** or **Grade 63LR Liquid Rouge.**

ULTRA-MIRROR FINISH...Proceed as with the mirror finish and follow with lamp black and kerosene.

THE LEA MANUFACTURING CO.

16 CHERRY AVE., WATERBURY 20, CONN.

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Lea Mfg. Company of Canada, Ltd., 1236 Birchmount Road, Scarborough, Ontario, Canada
Lea Mfg. Co. of England, Ltd., Rock Terrace, Buxton, Derbyshire, England
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Manufacturing Plant: 235 East Aurora St., Waterbury 20, Conn.

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AURALL GOLD* (24K)

passes the toughest nitric acid test

Pieces . . . . . electrical connectors
Plate . . . . . 100 millionths of an inch
Place . . . . . customer's plant
Test . . . . 30 minutes in boiling concentrated nitric
Results . no sign of corrosion or attack on base metal

Comparative tests on parts plated with same thickness of gold from both conventional cyanide and acid golds showed complete attack of the base metal in less than 10 minutes.

Make this simple comparative test with your own gold plate and see the advantages the Aurall Gold offers you. It is possible to obtain complete protection with lesser thickness of plate with Aurall Gold, thereby saving in gold.

Aurall Gold will provide not only the answer to simplification of your plating operations but substantial improvements in corrosion protection, freedom from porosity, and the ability to withstand high temperatures without discoloration.

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- ★ Bright to lustrous, all-inclusive 24K gold plating process.
- ★ Exceptional resistance to high temperature discoloration.
- ★ Meets critically exacting industrial and scientific requirements where high degree of ductility, freedom from porosity and excellent solderability are required.
- ★ Completely stable bath; operable over a wide temperature range; excellent throwing power.
- ★ Combines advantages of cyanide and acid baths in one solution that does not deteriorate with age or in prolonged operation.
- ★ Simple to operate; easy to control.

*Patents pending

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Platinum Bath

U. S. Patent 2,984,604. *May* 16, 1961. *R. Duva and E. C. Rinker, assignors to Sel-Rex Corp.*

A process for electroplating relatively thick layers of stress-free platinum comprising dissolving platinum diamino dinitrite in an aqueous solution of sulfamic acid containing a sufficient amount of sulfamic acid to dissolve said platinum diamino dinitrite, adding water to the resultant solution to provide a solution containing at least 6 g./liter of platinum metal and electrolyzing said solution to plate out platinum therefrom.

Ultrasonic Cleaning Unit

U. S. Patent 2,985,003. *May* 23, 1961. *L. Gelfand and G. B. Long, assignors to General Motors Corp.*

In a cleaning machine for articles including a liquid container adapted to contain the articles and a cleansing liquid, a plurality of individual ultrasonic transducers associated with and effectively distributed relative to the liquid container to transmit their vibrations to any foreign matter adhering to the articles, a low power high frequency oscillator having insufficient power to simultaneously oscillate all of said ultrasonic transducers at maximum effectiveness, individual frequency matching controls for said individual transducers, and a continuously operable power operated selector switch means for connecting said low power oscillator consecutively with each individual transducer in repeated cycles.

Black Chromium Process

U. S. Patent 2,985,567. *May* 23, 1961. *H. L. Pinkerton, assignor to Allied Chemical Corp.*

The process of electrodepositing an adherent black chromium coating on an electrically conductive member, which process comprises making the member a cathode in an aqueous electroplating solution consisting essentially of chromic acid in an amount of at least 60 grams per liter, and a fluorine-bearing catalyst ion in amount such that the ratio of chromic acid (CrO_3) to said fluorine-bearing ion is within the range of from 125 parts by weight of CrO_3 to 1 part of fluorine-bearing ion to 4,000 parts of CrO_3 to 1 part of fluorine-bearing ion, said solution being substantially completely free of other catalyst ions, and passing a direct current through the member at a current density of from 75 to 450 a.s.f. while maintaining the temperature of said solution within the range of from about 70°F. to 100°F.

Spray Coating Applicator

U. S. Patent 2,986,338. *May* 30, 1961. *R. D. Foster, assignor to Crutcher-Rolfs-Cummings, Inc.*

A rotary hollow head for receiving on the rotational axis thereof a stream of liquid paint and through centrifugal force on the liquid causing the same to be evenly spread circularly and outwardly to the rim of the head and to be projected therefrom in mist form.

Electropolishing Steel

U. S. Patent 2,986,499. *May* 30, 1961. *C. J. Wernlund, assignor to E. I. du Pont de Nemours and Co.*

The process for electropolishing ferrous articles which comprises anodically removing iron from said article and depositing iron on the cathode in an electrolyte containing by weight between about 10% and 40% water, 0.5% to 48% fluoboric acid and the balance iron fluoborate.

Vapor Phase Corrosion Inhibition

U. S. Patent 2,986,447. *May* 30, 1961. *P. J. Raifsnider, assignor to Shell Oil Co.*

In a process for the vapor phase corrosion inhibition of metallic surfaces at temperatures between about 30°F. and about 110°F. in the presence of water vapor, wherein a metallic object is enclosed in a wrapping material, the improvement which comprises enclosing a corrosion-inhibiting amount of capric acid as the sole vapor phase corrosion inhibitor with the metallic object for a period of at least 8 hours.

Bright Nickel

U. S. Patent 2,986,501. *May* 30, 1961. *B. F. Martin, assignor to The McGean Chemical Co.*

An electroplating bath for the production of bright, level deposits of nickel, which comprises an aqueous acid nickel electrolyte solution containing a predominating amount of a soluble nickel salt and having incorporated therein a leveling and brightening agent selected from the group consisting of hydroxymethyl, hydroxyethyl and hydroxypropyl coumarin, wherein the substituent groups in said agent are attached to the coumarin nucleus in at least one of the 5, 6, 7 and 8 positions, said agent being present in solution in effective amount ranging from at least 0.05 g./l. to the limit of its solubility.

Phosphating Composition

U. S. Patent 2,986,482. *May* 30, 1961. *J. A. Sharp, assignor to Canadian Industries Ltd.*

A substantially anhydrous composition suitable for cleaning and phosphating metal articles, which consists essentially of a chlorinated hydrocarbon degreasing solvent containing from about 1% to 10% by weight of at least one sorbitan monoester of an aliphatic acid having from 12 to 18 carbon atoms per molecule, and from one to six moles of phosphoric acid per mole of sorbitan monoester.

Bright Nickel

U. S. Patent 2,986,500. *May* 30, 1961. *F. Passal, assignor to Metal & Thermit Corp.*

In the process of electroplating nickel from nickel-containing baths, the improvement which comprises incorporating in said baths between 1 g./l. and 25 g./l. of a secondary brightener characterized by having at least one group selected from sulfone and sulfonic acid groups attached to a nuclear carbon of a homocyclic aromatic ring, and between 0.05 g./l. and 1.2 g./l. of N-vinyl-2-pyrrolidone, whereby lustrous nickel electrodeposits are obtained.

Soak Cleaner

U. S. Patent 2,986,526. *May* 30, 1961. *J. T. Crowther, assignor to Nalco Chemical Co.*

The process of cleaning carbonaceous and other dirt from ferrous metal surfaces without leaving harmful deposits or an oil film on the metal surfaces, with no more than slight foaming of cleaning composition and without formation of precipitates in said cleaning composition or film at the surface thereof, which process comprises flushing said ferrous metal surfaces with an 0.5% to 10.0% by weight aqueous solution of a water soluble metal cleaning composition consisting essentially of:

Ingredients	*Per cent by Weight*
A. Tetrasodium pyrophosphate	98-99.2
B. Dodecylalcohol reacted with 8 to 12 mols of ethylene oxide	0.8- 2.0

Silicon Rectifiers

Allied Research Products, Inc., Dept. MF, 4004-06 East Monument St., Baltimore 5, Md.

A new line of compact silicon rectifiers features a small size, lower price, flexibility in arrangement and exclusive protective devices.

Although the cabinet size has been reduced by 45%, the new line matches standard sized rectifiers in performance, it is claimed. Over-size heat sinks and increased capacity of diodes reduce danger of overheating. An extra-large fan draws air over the heat sinks and transformers and keeps ambient temperatures well below critical stage.

Building block design of the new rectifiers allows use in either a vertical or horizontal position, and permits easy addition of extra capacity by stacking rectifiers on top of one another or placing them side by side. All rectifiers feature exclusive protective devices to protect against single phasing, excessive temperature, AC overload or DC overload. A special air flow indicator shows exactly how much air is flowing through the rectifier and also indicates when to clean the plastic, washable air filter.

Units are available in capacities of 1000, 1500, 2000, 2500 and 3000 amperes with a wide choice of control regulation.

Non-Fuming Pickling Salts

Enthone, Inc., Dept. MF, 442 Elm St., New Haven 8, Conn.

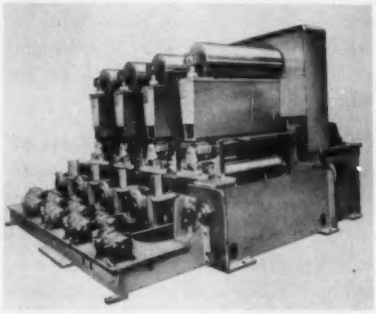
Enth-Acid 97, an inexpensive non-fuming pickling solution for copper, brass, aluminum and many other non-ferrous metals, is a safe and economical powdered replacement for hazardous nitric and sulfuric acids. It effectively removes heat treat scale and oxides, including red cuprous oxide from copper alloys, and copper smut from aluminum alloys. It has proven advantageous prior to electroplating to activate difficult-to-plate alloys, such as beryllium copper, leaded brass, phosphor bronze, and tin-lead solders with a minimum loss of metal.

The material consists of two easy-to-handle powdered products, 97A and 97B, which are added to water to produce the operating solution. A ratio of ¾ lb./gal. 97A to 1¼ lb./gal. 97B is recommended. The work is simply immersed in the solution for a period of one to three minutes at room temp.

Due to freer rinsing there is less dragout and a longer life for the solution. During use, the solution does not heat up, therefore eliminating the need for cooling coils or water jackets.

Multiple Head Flat Polisher

Hill Div., Hill Acme Co., Dept. MF, 1205 W. 65th St., Cleveland 2, Ohio.



This four-head belt polishing machine for the progressive finishing of stainless steel coiled strip will process material 0.010" to 0.250" thick and 50" wide. The entire unit requires only half the floor space of four conventional strip grinders and the flexible design permits the addition of any number of additional grinding heads.

Each head is composed of an endless abrasive belt running over a two-roll head with a motorized adjustable steel billy roll for increasing the belt pressure against the steel strip. The belt on any head can be changed while the others are in operation. Rubber covered guide rolls, built into the machine, create the proper "break" angle of the strip over each billy roll to flatten the strip at the point of contact with the abrasive belt.

For heavy stock removal "wet" grinding is recommended with 600 gpm coolant. Sludge passes through the bottom of the machine to the filter units. A built-in oil mist spray system is used in finishing operations.

Centrifugal Dryer

Udylite Corp., Dept. MF, 1651 E. Grand Blvd., Detroit 11, Mich.

A new centrifugal dryer for the electroplating industry uses a completely new heat circulation design to boost efficiency and cut drying time. The duct system is specially designed to permit the heater to be mounted in the rear of the dryer. Heat is drawn through the ducts in the cover and over the work at a more efficient rate. A central drive shaft mounted on Timken roller bearings in a reinforced welded base adds service life to the dryer. Rugged power drive easily handles heaviest production loads. The totally enclosed, fan-cooled, extractor-design ball bearing motor has a positive electric brake for quick smooth stops under load. Controls are front-mounted within easy reach of the operator.

Spray Booth Coating

Kelite Corp., Dept. MF, 81 Industrial Road, Berkeley Heights, N. J.

Paint Guard, a new and improved paint spray booth coating, is ready for use without dilution. It is a non-tacky paste, odorless, non-toxic, and non-flammable.

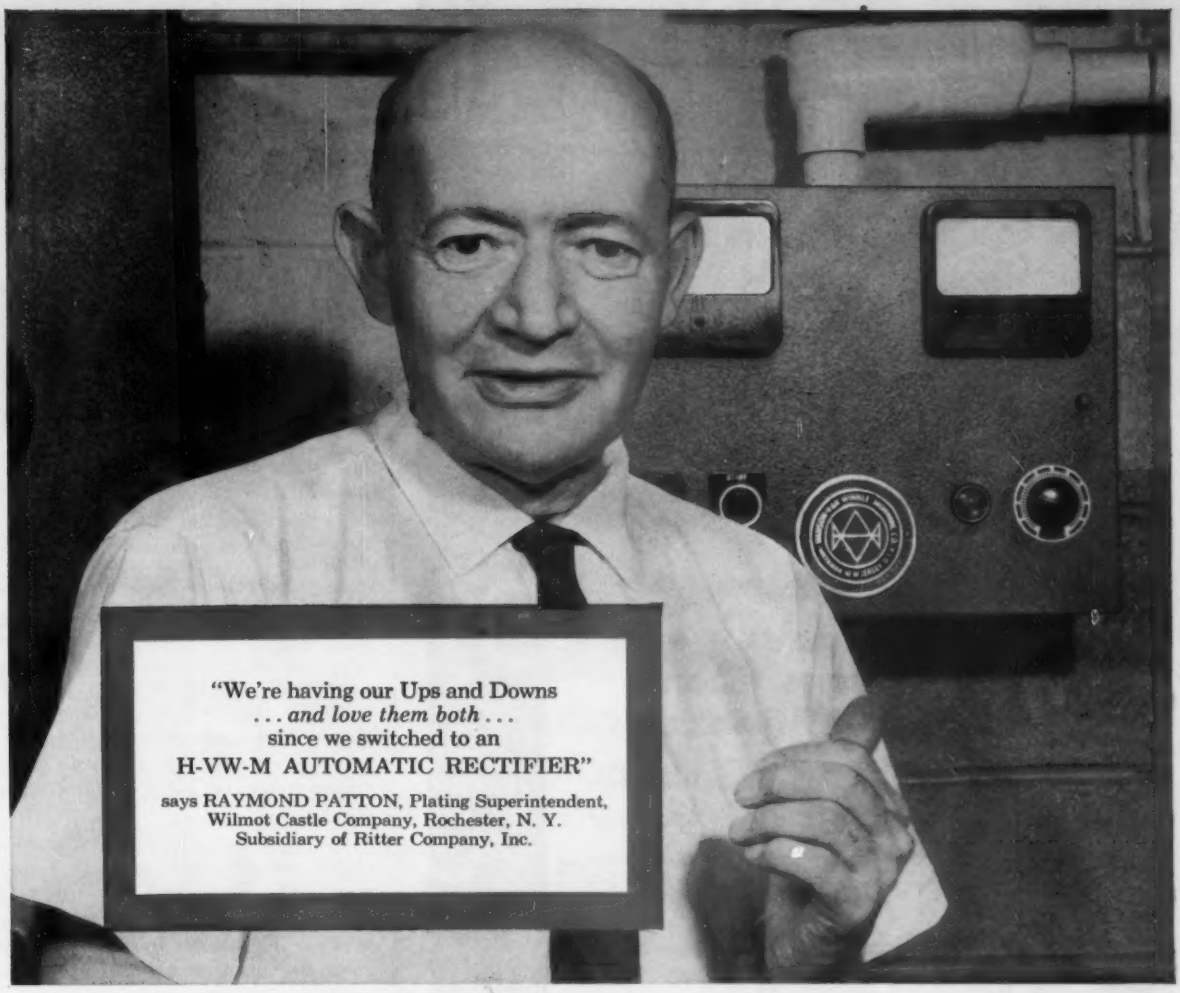
The material is easily applied by brush or spray to form a protective coating of high light reflectance and low specular gloss, making it ideal for booth coating. It readily lends itself to "sandwiching." When paint accumulations become heavy, the coating is quickly removed by scraping, pressure water spray, or steam cleaning. Two additional advantages are that it exhibits rust inhibitory properties and does not pick up on workers' shoes or truck wheels.

Titanium Anode Baskets

Vulcanium Corp., Dept. MF, P.O. Box 187, Highland Park, Ill.

Specially large titanium baskets, 10" x 12" x 78", are being fabricated for high production nickel plating operation — 1,000 lbs. of nickel anodes to be contained in each basket.

These baskets permit virtually 100%


"We're having our Ups and Downs
... and love them both ...
since we switched to an
H-VW-M AUTOMATIC RECTIFIER"
says RAYMOND PATTON, Plating Superintendent,
Wilmot Castle Company, Rochester, N. Y.
Subsidiary of Ritter Company, Inc.

UP 5% goes production...
DOWN 25-30% go dial manipulations

Requirements for current vary widely in the chrome-plating operations of Wilmot Castle Company, one of the largest makers of sterilizers, lamps, and other hospital, dental, surgical equipment.

Added to the normal trickiness of chrome is the fact that the company plates some 300 different parts—ranging from a few ounces to 50 lbs. in weight. With the manual tap-switch rectifiers used before, a lot of time was spent in twiddling dials to meet correspondingly large swings in current needs.

But now... with the new Automatic Rectifier from H-VW-M... dial setting remains the same. Current is adjusted automatically for changes in load. With human error removed, rejects are down 5%. Plate is more uniform—for while the old method provided 44 steps of control, with Automatic Voltage Stabilization, control is stepless, virtually infinite.

Says Ray Patton, Wilmot Castle's plating superintendent: "We're gradually retiring all our rectifiers of the tap-switch type—and putting in H-VW-M units that practically think for themselves. We've found that what they seem to think about the most is ways to up our production, cut our costs down."

If that kind of thinking appeals to you—whether you're doing chrome-plating or any other kind—phone or write H-VW-M for details on the most complete line of plating rectifiers featuring Automatic Voltage Stabilization.

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Alkali and Emulsion Cleaners
Rust-Proofing Materials
Vapor Generators
Phosphate Coating Compounds
Paintbond Compounds
Extrusion and Drawing Compounds
Spray Booth Compounds
Industrial Washers

utilization of the metal, according to the manufacturer, thus avoiding waste or reprocessing of anode materials. Anode hooks are eliminated.

Vibratory Finishing

Pangborn Corp., Dept. MF, Hagerstown, Md.

Work may be fed or conveyed automatically into and out of these machines. Media are automatically cleaned, screened and recirculated. Compound and water are also added automatically.

The new continuous process machines use the same gyratory action and special air-cushion suspension as standard type units. Continuous conveyance of fixtured large and heavy parts can be arranged through these machines. The elongated work containers also may be adapted to batch type processing of very long parts.

The new machines are available in a range of sizes.

Clear, Organic Finish

J. G. Holley, Inc., Dept. MF, Dover, N. J.

A polyurethane-based, clear finish called "Formula P" air-dries in 45 minutes. It is claimed to be very pliable and won't shrink or crack. It is self-leveling, easily sanded, highly resistant to acids, weather and scuffs and has extremely effective bonding qualities on new surfaces. It will store indefinitely.

Polyethylene Containers

Delaware Barrel & Drum Co., Dept. MF, Wilmington, Del.

These tough, dependable, one piece molded polyethylene featherweight containers are manufactured in five and fifteen gallon sizes and are available with either steel or fibre over-

packs and a variety of closures, including retractable pour spouts, plugs and caps, to insure safe shipping and ease of dispensing.

The five gallon and fifteen gallon featherweight polyethylene containers in steel comply with ICC-37P Specifications. The five gallon and fifteen gallon containers in fiber comply with ICC-2U and ICC-21BP Specifications.

Buffing Compound Cleaner

Cowles Chemical Co., Dept. MF, 12000 Shaker Blvd., Cleveland 20, Ohio.

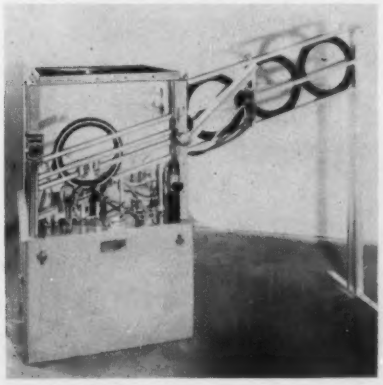
A new compound for cleaning bar and liquid type buffing compounds from zinc base die castings, Buff-Off is said to be the most effective and lowest cost buffing compound cleaner available.

The cleaner contains no amines, thus eliminating the contamination which often interferes with good plating operations. Simplified control procedures are possible because the material is stabilized. The company claims the cleaner will not streak, etch or darken castings. The problem of "stardust" in the finished plate is eliminated. A five-minute soak with mild agitation is recommended, although three to three and a half minutes will prove adequate in some cases. A simple titration determines concentration in a few moments.

Automatic Spraying Machine

Conforming Matrix Corp., Dept. MF, 780 New York Ave., Toledo 11, Ohio.

A new automatic spray machine which, without the use of masks or tape, simultaneously paints a stripe on both sides of round parts, which can be rotated during finishing. It is quickly and easily adjustable for various size diameters. An automatic posi-



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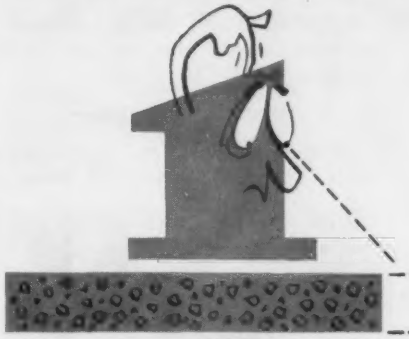

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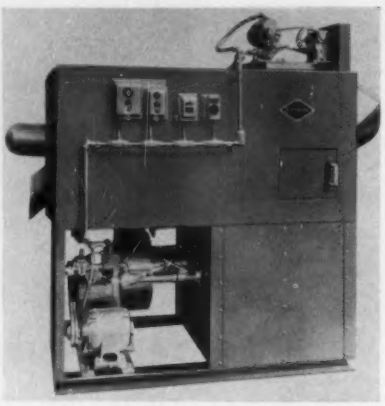
tioner accommodates variables in parts.

The machine (illustrated), which is of modular construction, and measures 38″ x 38″ x 56″ high, provides for chute loading and automatic unload. Of loading height, the escapement chute is 48″ x 49″. The skip spray device paints only when the part is in position.

Rotary Drum Dryer

Alvey-Ferguson Co., Dept. MF, 3131 Disney St., Cincinnati 9, Ohio.



Designed especially for use in mass production in the plating industry, this small (3′ x 6′ floor space) rotary drum type drying machine, which is provided with a 24″ diameter drum, is gas heated and recirculates hot air for maximum economy. Fire box, heating and blower assemblies are located under the drum and out of the way. The machine is completely assembled and wired and ready for connection to services.

Portable Blower

Manhattan Electric and Maintenance Co., Dept. MF, 24 Siegel St., Brooklyn, N. Y.

An all-aluminum portable blower, weighing approximately 70 lbs. and delivering up to 6500 cu. ft. of air a minute, is available in both standard and explosion-proof models. It is powered by a 1½ hp motor and supplied for use with either 220-440 volt A.C., 110-230 volt A.C. or D.C. Overall dimensions are: length— 21⅛ in., height— 21 in., width— 20¾ in., air duct— 18 in.

The No. 18-N-52A1 blower may be operated in any position without loss of efficiency. Safety features include water-proof and vapor-proof switch, screen guards on both inlet and exhaust, balanced fan blades and thermal overload protection which safeguards the totally enclosed motor against damage from single phasing, overloading and overheating.

Aluminum Cleaning-Conversion Coating

Hughson Chem. Co., Dept. MF, Erie, Pa.

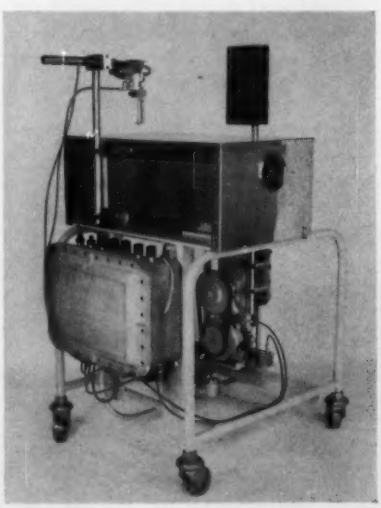
A combination cleaner and chemical surface treatment for aluminum, designated as EX-B727-6, is a translucent, organic paste, easily applied by spraying, brushing or wiping. Chemical reactions which occur during drying produce an organic conversion coating on the metal surface. Rinsing off the dried paste leaves a surface with exceptional adhesive properties for bonding or coating, it is claimed. This paste also serves as a superior surface cleaner for stainless steel and chrome-plated surfaces.

Test Panel Spraying Machine

Spraymation, Inc., Dept. MF, 25 Amity St., Little Falls, N. J.

Model C9125 Automatic Panel Spraying and Lapping Machine is the first commercially available unit designed to permit three axis spraying and lapping of test panels on a fully automatic basis without operator attention.

A spray gun is traversed in front of the test panel, which is automatically raised or lowered in steps of two inches while the gun is turned off at the end of each spray stroke. The panel will be completely sprayed for its full length and automatically returned to the start position. There is then a timed flash period after which subse-



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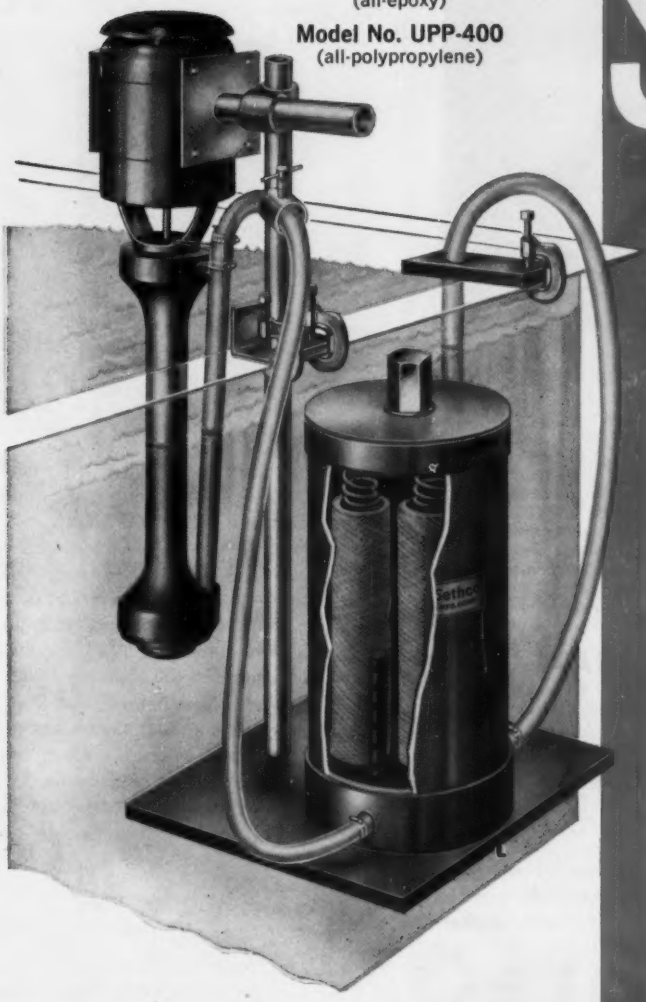

New, improved SETHCO In-Tank Pumps (epoxy or polypropylene) and Detachable Outside Filter Chambers have won popular acclaim in the industry for trouble-free performance and flexibility in filtering all electroplating solutions. Full-view filtration can be provided with lucite, epoxy-pyrex or polypropylene-pyrex for constant visual inspection of the filtering process. All models provide swift cartridge cleaning without disturbing tank operation.

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From pH 0 to pH 14
From 70°F. to 250°F.

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- Filter systems available in polypropylene and teflon for chromic acid and other oxidizing acids.
- Easy control of degree of filtration from 150 down to 1 micron.
- Tubes filter in depth, eliminate binding effects, channeling and rupturing hazards common to surface type filters.
- Filters from all levels — depth extension assembly available to filter from bottom of tank, skimmer available to keep surface free of dirt.
- Pump fits anywhere on tank, saves floor space, (5½" diam. 4½" immersion depth); minimum displacement in tank.
- Open pumping capacities 900-3600 gal/hr.
  Filter chamber capacities 50-2700 gal/hr.
- Available with ½, ¾, and 1 HP motors to accommodate all size filter chambers.
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quent coats will be applied. The distance from the gun nozzle to the panel is automatically changed in order to simulate hand spraying conditions.

Any of three pre-selected cycles may be obtained instantly through use of a selector switch on the control console. This gives a fully automatic cycle to carry out the necessary flash periods and spray passes required for the specific material being sprayed.

The speed of traverse of the panel can be varied as required, and a tachometer indicates the speed in progress.

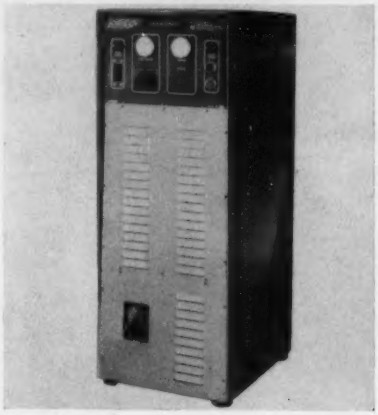
Selenium Rectifier Stacks

Semiconductor Div., Syntron Co., Dept. MF, Homer City, Penna.

A high density selenium rectifier, with current ratings of up to three times those of comparable-sized standard selenium cells and stacks, the Mark V is available in cell sizes of from 1-inch by 1-inch, through 12-inches by 16-inches, in both 26 volts and 33 volts RMS. Current ratings range from 0.46 ampere to 379.2 amperes at maximum ambient temperature of 40°C., and up to 948 amperes in force-cooled applications.

Ultrasonic Generator

Branson Instruments, Inc., Dept. MF, 40 Brown House Road, Stamford, Conn.



The largest single-unit ultrasonic generator to feature automatic load compensation, Model LG-3500A Sonogen offers an average power output of 3500 w, with a peak on pulses of 7000 w. The automatic load system compensates for both frequency and impedance simultaneously, to keep the acoustic energy in the cleaning system at a peak performance level.

Heavy duty components assure maximum useful operating time, and long life of the generator. Housed in an aluminum cabinet and designed for easy maintenance access, the generator measures 18 x 24 x 48 in. high.

Rust Remover

Sloan Chemicals, Inc., Dept. MF, Caxton Bldg., Cleveland 15, Ohio.

Aci-Gel, an entirely new type of rust remover, is a multi-acid material which removes rust to bare metal by chemical action. It brushes on, flushes off with water, leaving a clean surface for painting.

The material, suspended in a thixotropic gelling agent, clings to vertical surfaces, will not sag.

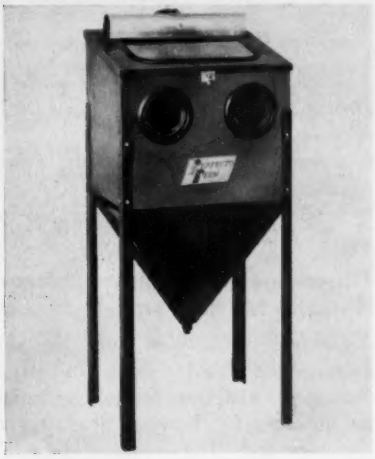
Dry Blasting and Peening Machine

Perfecto-Peen Div., Aero-Test Equip. Co., Inc., Dept. MF, 8401 Chancellor Row, Dallas, Tex.

Model DV100, it is claimed, features

low operating cost with minimum air supply, filling a factory-shop need for a time-saving piece of cleaning and peening equipment at a low price. Air required is only 60 p.s.i. (minimum), 15 c.f.m. A 1½ H.P. compressor, and a 60 gallon tank are usually adequate for most operations desired.

The unit accommodates five to six pounds of abrasive material per loading and has a replaceable dust filter. Material life is approximately 25 hours of operating time. Height of the



machine, which is adjustable, is a maximum 57″ and 52″ minimum; width, 23″; depth (work area), 15″; weight, 100 lbs.; electrical requirement, 110 VAC.

Optional equipment includes a fixed gun attachment stand, designed to mount gun so that both hands are free for manipulation of parts, and a foot-operated valve. Also optional is a blow-off gun mounted inside the cabinet for blowing dust from parts prior to removal from cabinet.

Ultrasonic Degreaser

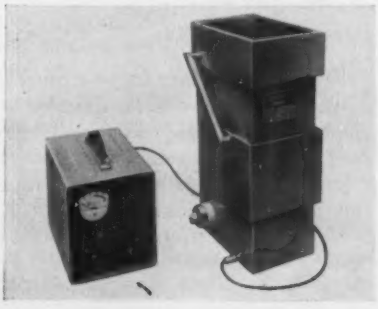
National Ultrasonic Corp., Dept. MF, 95 Park Ave., Nutley 10, N. J.

These two stage ultrasonic degreasers have been designed specifically for use with Freon TF solvent, recommended for cleaning parts containing any plastics, metals, elastomers, or insulations which would ordinarily be attacked by chlorinated solvents such as trichlorethylene and perchlorethylene.

Parts are first placed in the ultrasonic chamber to remove or loosen all contamination. They are then transferred to the vapor area where they receive a final cleansing in pure distilled Freon vapors. They emerge from the unit completely clean and dry.

All units are self-distilling permitting continual re-use of the solvent. Units are furnished with a top flange to permit dropping in a bench top for use with a remote control generator.

These bench model ultrasonic cleaners are available in three sizes, each with its specifically matched generator for maximum ultrasonic energy penetration. The ultrasonic barium titanate transducers are sealed in stainless steel casings and permanently affixed to the bottom of the machine.



Power Rectifiers

Gates Electronic Co., Dept. MF, 2243 White Plains Ave., Bronx, N. Y.

A new line of silicon and selenium type DC power supplies features voltmeter and ammeter, powerstat voltage control, 2% voltage accuracy and conservatively rated components and construction for long trouble-free life. They are in stock from 10 to 200 amperes.

NO HIGHER QUALITY
CAN BE DELIVERED
SO CONSISTENTLY...
99.75+% PURE
BFC
Extra High Purity
CHROMIC ACID
FLAKE
And you get prompt delivery from ample factory and nearby distributor stocks.
Next time you're in the market why not send us a modest order just to find out how good BFC Chromic Acid really is.
BETTER FINISHES & COATINGS, INC.
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Don't throw it away! **RECOVER**

YOUR ALUMINUM BRIGHT DIP SOLUTION

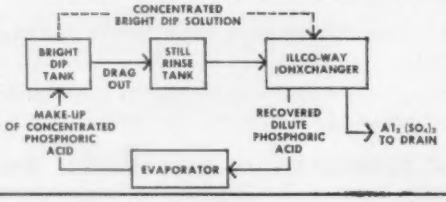
ILLCO-WAY

ionXchange

SPECIALIZED EXPERIENCE SHOWS HOW TO SAVE MONEY

The use of ion-exchange eliminates the need for dumping expensive phosphoric acid. Four years of successful experience in recovery of bright dip solutions enables us to make several recommendations, depending on particular conditions. Usually, we employ a cation exchanger to purify the first rinse, recovering phosphoric acid which has been carried over from the bath by dragout. Another treatment removes aluminum direct from the bath. The use of IWT ionXchange can not only improve the uniformity of your product through better quality control in the plating, but also can be a very *profitable* investment.

PROCESS CAN BE USED IN SEVERAL WAYS



The block diagram at the left illustrates the general methods of treatment suggested above. Actually, every installation presents its own special problems — which IWT engineers are well-equipped to solve. *So, consult your IWT representative for specific suggestions.*

ILLINOIS WATER TREATMENT COMPANY

840 CEDAR STREET
ROCKFORD, ILLINOIS

NEW YORK OFFICE: 141 E. 44th St., New York 17, N.Y.
CANADIAN DIST.: Pumps & Softeners, Ltd., London, Ont.

President Harold Leever, in the traditional scottish costume, presents a wrist watch and 25-year pin to vice-president and secretary Tom Downie, and his wife, Mae, at the company's annual outing.

BUSINESS ITEMS

Formation of New Corporation Announced

Harold G. Abbey has announced the formation of a new corporation, the *Abbey Automatic Systems, Inc.*, to design and manufacture automatic plating and finishing equipment using his complete series of patents. All manufacturing and engineering will be carried out on the premises of a building now being made available.

In addition to the manufacture of equipment, the firm will supply the design and installation of all types of finishing and conveyor equipment, including complete plants for plating, polishing, and spraying. A complete staff of service and technical engineers will be available for study and counsel.

MacDermid Distributes Service Award Pins

Service Award Pins for service from 25-years to 5 years were presented to employees of *MacDermid Inc.*, Waterbury, Conn., by president *Harold Leever*, at the company's annual outing following a sales meeting.

15-year pins: *Gerry Sullivan, Ed Stack, Doug Lunan.*

10-year pins: *Virginia Leever, Gordon Jones, Al Butterer, Terry Caldwell, Doctor Taylor, Irene Granoth* and *Dick Nyquist.*

5-year pins: *Harold Lazaar, Ethel Corrigan* and *Jerry Post.*

Service pins were also presented to wives of the men who received awards.

Conversion Chemical Appoints Licensee

Conversion Chemical Corp. has announced the licensing of *Dr. Ing. Max Schlotter*, Geislingen/Steige, Germany, as licensees for Kenvert products in Germany and "The Common Market." The Schlotter organization has been identified for many years as suppliers to the metal finishing trade, and are actively engaged in production of equipment and materials to all phases of the industry.

Kenneth Bellinger, president of Conversion Chemical, has recently returned from a trip to Germany and England, visiting the Schlotter organization and the English licensee, Silvercrown Ltd.

DeVilbiss Adds Australia Facilities

Establishment of a spray equipment manufacturing and distributing facility in Australia through an agreement with a large Australian company has been announced by the *DeVilbiss Company*. The affiliate, known as *Arnold-DeVilbiss Pty., Ltd.*, has headquarters in Sydney, New South Wales. The Australian associate is C.I.G., Ltd., a manufacturing concern which has produced the Arnold line of spray painting equipment for 25 years and which will now also make and sell the DeVilbiss line.

The combined line will be available through all C.I.G. operating companies and existing Arnold distributors as well as through Excelsior Supply Co. Pty., Ltd., which has handled the firm's

products in Australia for many years. Export rights for designated areas are also included in the agreement.

Promotions at Ramyr Mfg.

Ramyr Mfg. Co. has appointed *B. G. Rhodes* to the position of vice-president-sales and customer services. At the same time, *Edward D. Heiden* was promoted to vice-president-administrative, with special assignments in product engineering.

Kanigen Div. Seven-State Area Processing License to Grunwald

Grunwald Plating, Inc., has purchased the processing license covering a seven-state area from the Kanigen Division of *General American Transportation Co.*, East Chicago, Ind. Plant, equipment, and electroless nickel plating facilities are included in the sale.

General American will continue to apply processing to tank cars at the organization's Sharon, Pa. plant, but all other custom plating operations will be removed to the Grunwald premises at 2559 W. 21st St., Chicago.

Sel-Rex Promotes Ross

The promotion of *Jerome L. Ross* from assistant manager to general manager of *The Meaker Co.*, subsidiary of *Sel-Rex Corp.*, was announced recently. Sales engineer with the firm since 1949, Ross was in charge of plating equipment and supplies sales for two years, and had also been manager of the company's Equipment Division, responsible for engineering and pricing.

Prior to joining the company, Ross, a chemical engineering graduate of Columbia University, had held technical, administrative and executive positions in the metal finishing industry for nearly twenty years.

Jerome L. Ross

National Ultrasonic Names Kendall

Raymond C. Kendall of Fayson Lakes, Butler, N. J., has been appointed sales manager of *National Ultrasonic Corp.*, Nutley, N. J.. In his new position, he will be responsible for the national sales and distribution of ultrasonic cleaning equipment. Mr. Kendall brings to his new association a wealth of experience in the fields of ultrasonics and metal cleaning.

Mr. Kendall received his B.S. degree in Mechanical Engineering from the University of Connecticut. In 1938, he joined G. S. Blakeslee & Co., manufacturers of metal cleaning equipment. After 14 years service, he became owner and manager of Kendall & Co., Southington, Conn. specializing in metal cleaning.

A Navy Lieutenant during World War II at Boston Navy Yard, he was supt. of new construction of destroyers, destroyer escorts, landing ship drydocks and landing ship tanks. Before joining National, Mr. Kendall was field engineer of ultrasonics for Gulton Industries, Inc., Metuchen, N. J.

Wyandotte Names Sales Manager

George P. Bailey has been named resident sales manager, *Wyandotte Chemical Corp.* J. B. Ford Division, with offices in the San Francisco area.

Mr. Bailey, for 10 years with the company, has been located in Cali-

HAMMOND MODEL VRRO
Two-Spindle Variable Speed Lathe

STEP UP PRODUCTION—REDUCE FINISHING COSTS with Hammond DOUBLE SPINDLE LATHES

- No "down time" for one operator when the other changes wheel — each operator has his own motor, control and variable speed drive.
- Convenient Variable Speed dial is within arm's reach of the operator — no "climbing" around in back to change speeds.
- Wheel economy and better finish. As wheel wears each operator can increase speed — to maintain constant peripheral speed for uniform and better finish, maximum production and wheel life.
- Available in 4 sizes — two 5 HP, two 7½ HP, two 10 HP or two 15 HP.

ALSO AVAILABLE IN WIDE SWING MODEL VRROW

Wide swing construction, with extended bearing housings and spindles, provides additional working space for large, bulky pieces.

Cost reduction is the need of the day — Write for catalog.

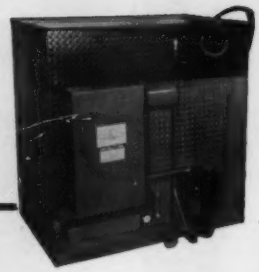
Hammond OF KALAMAZOO "Good Machinery Since '82"

Hammond Machinery Builders INC.

1601 DOUGLAS AVE. — KALAMAZOO, MICHIGAN

Phillips
ALL-ELECTRIC
PERCHLORETHYLENE
DEGREASERS

- REQUIRE NO WATER
- REQUIRE NO DRAINS OR CONDENSATE RETURNS
- REQUIRE NO UTILITY CONNECTIONS EXCEPT ELECTRICAL
- RECLAIM THEIR OWN SOLVENT AUTOMATICALLY



PHILLSOLV
A NONFLAMMABLE SOLVENT FOR USE IN THE PHILLIPS DEGREASER
PHILLIPS MANUFACTURING COMPANY - CHICAGO, ILLINOIS
DIAMOND ALKALI COMPANY - U.S.A.

PHILLSOLV, PHILLIPS' trade name for perchlorethylene, excels other degreasing solvents.

Here's why:

- SUPERIOR CLEANING ABILITY
- LOW TOXICITY
- HIGH BOILING POINT
- STABILITY WITH ALL METALS
- HEAVIER VAPORS
- LOWER EVAPORATION RATE
- NONFLAMMABLE — NON-EXPLOSIVE

PHILLIPS ALL-ELECTRIC vapor degreasers, designed for use with perchlorethylene, clean soiled parts faster and cost less to purchase and operate because:

HIGHER TEMPERATURE permits longer cleaning period; removes high melting point soils; permits greater solvent action.

HEAVIER VAPORS, 5.8 times heavier than air, reduces solvent loss from escaping vapor; reduces contamination of the atmosphere.

HIGH DENSITY AND HIGH GRAVITY VAPORS permit use in PHILLIPS ALL-ELECTRIC vapor degreasers without costly cooling coils and/or water jackets to control vapor levels.

Write for Bulletin 25 for all the facts on degreasing with PHILLIPS ALL-ELECTRIC degreasers and PHILLSOLV perchlorethylene.

Phillips
MANUFACTURING COMPANY
3475 Touhy Avenue
Chicago (Lincolnwood) 45, Illinois

DEGREASERS • WASHERS • DRYERS • ULTRASONICS • DEGREASING SOLVENTS

L. C. Sorensen

Corporation, manufacturers of industrial cleaning compositions, metal processing chemicals, and steam cleaning equipment, the following officers were elected:

L. C. Sorensen, chairman of the board, *William Sorensen*, president and *Louis McDonald*, executive vice-president.

L. C. Sorensen is the founder of the firm and served as its president from 1937 to 1961. He will continue as chief executive officer.

William Sorensen is a graduate of the University of California, where he majored in business administration. He joined the company in 1948 and has served in recent years as executive vice-president and marketing director.

Mr. McDonald is a chemical engineering graduate of the University of Virginia and is the holder of many patents in the chemical and detergent

George P. Bailey

fornia for the past five. He will head all sales activity in the San Francisco area and in the northern part of the state. His office is located at 1290 Bayshore Highway, Burlingame, Cal.

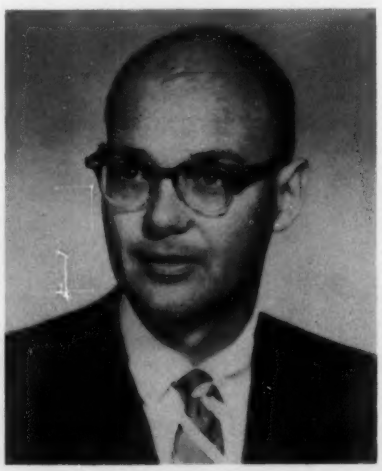
Rose Appointed by Clarkson Labs.

Philip F. Rose has been appointed director of sales for the *Clarkson Laboratories, Inc.*

Mr. Rose, formerly general sales manager of the Penetone Co., Tenafly, N. J., will be responsible for national and international sales.

Kelite Elects New Officers

At the regular organization meeting of the board of directors of *Kelite*



William Sorensen

Louis McDonald

field. He joined the firm in 1951 as laboratory director and subsequently became vice-president-technical director. He will continue as technical director.

National Science Foundation Grant Awarded to Kushner

Joseph B. Kushner, Professor of Engineering at Evansville College, and author and conductor of a correspondence course in electroplating, Evansville, Ind., has been awarded a National Science Foundation grant to conduct research on electrodeposition.

The sum of $8,300 was given to Evansville College to enable Dr. Kushner to carry on research on "The Theory of Stress in Electrodeposits" in the metallurgy laboratory of the college. The project will continue previous work done by Dr. Kushner in the field of stressed electrodeposits. The grant is believed to be the first National Science Foundation grant awarded for basic research in electroplating.

Joseph B. Kushner

Russell Elected President of Acoustica

Rollin M. Russell has been elected president of *Acoustica Associates, Inc.*, of Los Angeles.

Russell joined the firm early this year as executive vice-president. Previously, he had served as executive vice-president of Electronic Specialty Co., and as vice-president and group executive for Hughes Aircraft Co. He has also held executive posts with Continental Aviation and Engineering Corp.,

Rollin M. Russell

for long-lasting plating **TRIANGLE BRAND**
COPPER SULFATE
NICKEL SULFATE

TRIANGLE BRAND Copper and Nickel Sulfates help give you the hardness you need for long lasting plating. They have purity, uniformity, solubility and high conductivity. This all around dependability *does* make a difference. Therefore we suggest that you specify Triangle Brand Copper Sulfate and Triangle Brand Nickel Sulfate for all of your plating work. Send today for the free booklet "The Use of Copper Sulfate for Copper Plating."

Phelps Dodge also offers SELENIUM and TELLURIUM.

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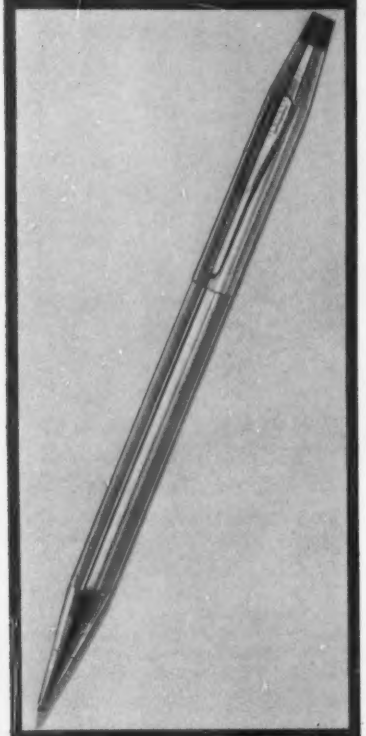
300 PARK AVENUE ■ NEW YORK 22, NEW YORK

■ The Part:

A. T. CROSS COMPANY AUTOMATIC PENS AND PENCILS



The Problem:

■ To buff high quality brass pen and pencil parts prior to chrome plating . . . to reduce the high cost of handling necessitated by manual buffing operations . . . to economically increase production without adding to the cost . . . to hold high quality standards set in manual operations.

A. T. Cross Company Put The Job On A Packer-Matic

For The Process see opposite page.

THE PACKER MACHINE COMPANY

456 Center Street
Meriden, Connecticut

and Bendix Pacific Division of Bendix Corp.

A graduate of the University of Wisconsin, Russell also took graduate training at Wisconsin and Northwestern University. He was associated with Johns Hopkins University's Applied Physics Laboratory and the Columbia University Underwater Sound Laboratory.

Selectrons Appoints New Distributor

Selectrons, Ltd., New York City, has appointed *Product Techniques Inc.*, 511 E. 87th Place, Los Angeles, Calif., exclusive western distributor for the company's selective plating plants. *Roger J. Haft* will supervise sales and servicing of these electroplating systems.

Product Techniques specializes in the manufacture of coating and plating materials for the metal finishing industries. Founded by a group of aeronautical engineers in 1947, the company has developed a number of materials and production techniques for aircraft, missile, and airborne electronic equipment.

Corporate Name Change

Butcher-Udylite de Mexico, S. A. de C. V. will now be known as *Udylite Mexicana, S. A. de C. V. C. Torres McDonald*, general manager, advises that the change was necessitated by corporate changes by the parent company, *The Udylite Corp.*

Michigan Oven Appoints New Representatives

Michigan Oven Co., Detroit, Ill., has announced the appointment of *Edward R. Talone* and *Charles F. Dilcher* as national sales representatives.

Talone will handle all sales-engineering activities for the firm in the Baltimore, Md. area. Dilcher will handle similar activities for the Atlanta, Ga. territory.

Talone holds a Mechanical Engineering degree from the University of Maryland and has over eleven years of experience in the industrial sales field with heavy emphasis on engineered oven systems, furnaces and related manufacturing equipment.

Dilcher is a graduate of Purdue University, with a degree in Mechanical Engineering. He was formerly with Sunbeam Equipment Corp., where he held the position of assistant chief engineer. He specialized in the engineering and development of industrial furnaces. In addition, he was chief engineer with Auto-Ponents, Inc. of Bellwood, Ill. He currently heads up Dilcher Engineering Co.

Synflex Div. of Moore Appoints Distributor

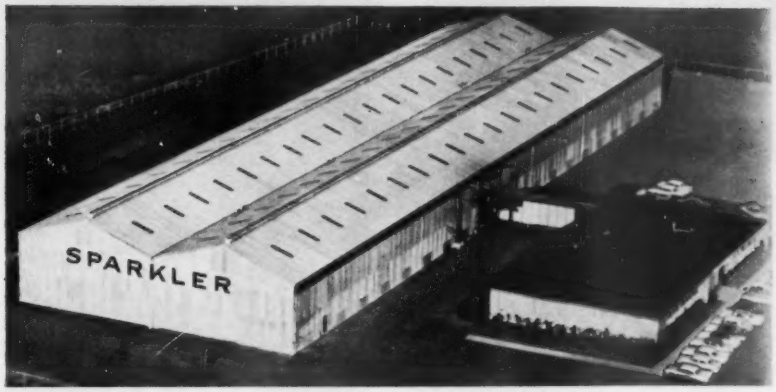
The Synflex Products Division of *Samuel Moore & Co.*, Mantua, Ohio, has appointed *Lucas Supply Co.*, Newark, Ohio as its authorized master distributor to stock its complete line of industrial hoses and tubing.

Magnus Holds Industrial Cleaning Seminar

More than sixteen countries were represented recently in an international industrial cleaning seminar conducted in New York City by *Magnus Chemical Co.* of Garwood, N. J.

The purpose of the week-long seminar was the interchange of information, ideas and problem solution that would benefit all the firms concerned with cleaning, etc.

Sparkler in Full Production at New Location



Sparkler Mfg. Co., engineers and producers of custom and standard diatomite filtration units for over 36 years, and originators of the horizontal plate filter, is now in full production at their new 70,000 square foot plant in Conroe, Texas. Their new plant features a streamlined, assembly-type production line built around the latest modern equipment.

The company was formerly located in Mundelein, Ill.

Schoonover Joins Despatch Oven

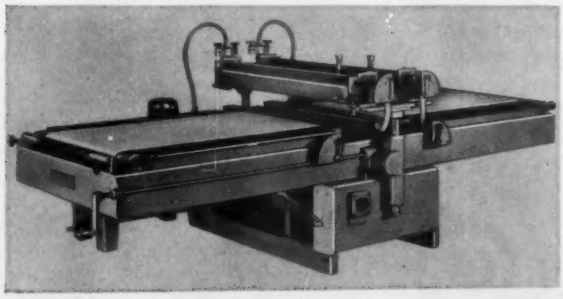
W. L. "Bill" Schoonover, Atlanta, has been appointed industrial representative for *Despatch Oven Co.*, Minneapolis. He will be the resident engineer servicing Georgia, South Carolina, and eastern Tennessee.

For the past eight years Mr. Schoonover has been associated with engineering staffs in the heat and chemical process industries in the southeast. Previous associations include Air Material Command U. S. Air Force, Dayton Ohio and Douglas Aircraft Co., Los Angeles.

Schoonover is a 1944 graduate of Purdue University, West Lafayette, Indiana. He earned a B.S. in E.E. degree. He did graduate study at Indiana Uni-

W. L. Schoonover

NOW JUST SET THE DIALS... GET UNIFORM FINISHES AUTOMATICALLY!



BURKLE FLOW-COATER

NO OVERSPRAYING No overlapping! Vastly speeds application, improves quality of finish. Dries fast!

Cuts material costs up to 40%

- Automatic application of lacquers, enamels, varnishes, polyester resins — with uniformity in continuous production — by maintaining optimum dial positions.
- On flat, curved, fluted or striated, convex, or concave surfaces on wood, metal, plastic, paper, canvas.
- Perfect results with unskilled labor!

Distributed exclusively by:

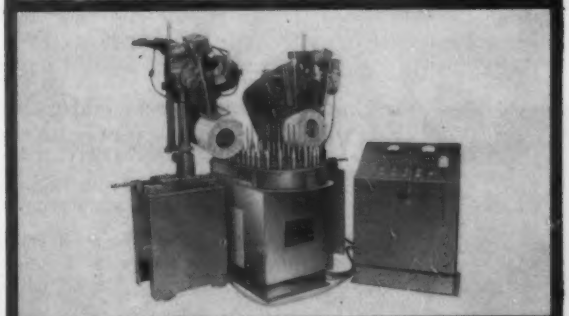
JOYCE RESEARCH AND DEVELOPMENT CORP.

249 W. Merrick Road, Valley Stream, N. Y. • LOcust 1-8697

W. (Sandy) Sandowski, President

■ **The Process:**

Buff On A Model 73 Packer-Matic



■ The compact Model 73 is a new horizontal conveyor type machine available in a variety of conveyor lengths depending on the number of heads required by the applications (A. T. Cross selected 2 heads). Conveyor speeds range to 4,000 parts per hour (A. T. Cross runs at 1200). The Model 73 handles tampico, sisal, wire wheels and cotton buff. (A. T. Cross chose cotton.) Simple tooling on the Model 73 made it highly adaptable to the handling of different sized pen and pencil barrels.

Bring Your Finishing Problem To Packer. Begin By Writing Today For Latest Descriptive Literature.

THE PACKER MACHINE COMPANY

456 Center Street, Meriden, Connecticut

versity in 1951 and 1952. He is a member of the Oak Ridge Chapter of the American Society for Metals. He is a member of American Vacuum Society, having recently served on the editing committee for symposium transactions.

Mr. Schoonover will have offices at 5071 Green Pine Drive, N.E., Atlanta, Ga.

Granquist Retires from H-VW-M

Ralph R. Granquist, Chicago district manager for *Hanson-Van Winkle-Munning Co.*, has retired after serving 38 years with the company.

Mr. Granquist joined the firm in 1923, beginning as a salesman in the Chicago office. During the late forties, he was one of the few company men to top the $1,000,000-a-year sales mark. In 1952, he was promoted to Chicago district manager and was responsible for sales in the midwest area until his retirement.

Ralph R. Granquist

Atlas Powder Changes Corporate Name

The *Atlas Powder Co.* announces that through the years its official name has become less descriptive as the firm became increasingly a manufacturer of chemicals, and so the corporate name has been changed to *Atlas Chemical Industries, Inc.*

New Division Established by Fidelity Chemical Products

A new Electronic Chemicals Division to manufacture and market a complete line of chemicals for applications in the electronics industries has been established by *Fidelity Chemical Products Corp.* of Newark, N. J.

The materials include descaling solutions, bright dips, cleaners, carbon removers, epoxy strippers for diodes and transistors, and special paint removers for custom type finishes used in the electronics industry.

Shockcor Joins Lancy Laboratories

Joe H. Shockcor has joined the staff of *Lancy Laboratories, Inc.*, Zelienople, Pa., as manager of the Philadelphia office. Previously he had been a district sales engineer with Enthone, Inc. for nine years, following a two year period in their laboratory working in

Joe H. Shockcor

research and in technical service. He is a graduate of Lehigh University and holds a BS degree in Chemical Engineering.

He has been active in the Lancaster Branch of the A.E.S., having held several offices and served on various committees. He presently is chairman of the credentials committee of the Supreme Society of the A.E.S.

Chandeysson Elects Altmeyer V.P.

The board of directors of *Chandeysson Electric Co.* has announced the election of *Charles E. Altmeyer* to the post of executive vice-president of the company.

Missar and Anderson Appointed by DeSota

R. R. Missar has been named product manager-metal decorating and coil coatings by *DeSoto Chemical Coatings, Inc.*, Chicago. He has been with the firm since 1947, serving in a number of technical and sales positions. Most recently he was a technical service representative at the Illinois Division in Chicago, working with container and coil coating accounts.

Wallace M. Anderson has been appointed technical assistant to the sales manager, paint and resin products. He has 24 years of experience in paint and coatings chemistry, the last six years of which were with the company. He has been located at the Eastern Division, Philadelphia, and at the Central Research Laboratories, Chicago.

New Appointments at Commercial Filters

Five new appointments have been announced by *Commercial Filters*

DEPENDABLE PPI PRODUCTS

RUBBER AND PLASTIC DRUM LINERS
MONEL, STEEL, COPPER AND TITANIUM ANODE HOOKS
PLASTIC COATED PAILS AND DIPPERS
POLYETHYLENE TANKS AND PAILS
TITANIUM ANODE SCRAP SAVER BASKETS
TITANIUM HEATING COILS
TRICHLORETHYLENE
PERCHLORETHYLENE
SILVER BRIGHTNER
SWIMMING POOL CHEMICALS
OIL ABSORBENT
ACID TANKS AND CONTAINERS
HAND CHEMICAL PUMPS

DURABLE • NON-BREAKABLE • STURDY

POLYETHYLENE CONTAINERS

TANKS ARE MOLDED IN ONE PIECE — WITHOUT SEAMS AND WITH INNER FLANGES FOR SUPPORT

PPI Containers will withstand most acids and alkalies at temperatures up to 160°F.

Tank Sizes and Prices

Stock No.	5-PT	15-PT	30-PT	55-PT
Capacity (gals)	5	15	30	55
Height	13⅜"	20½"	27"	32¼"
Outside Dia.	11"	14½"	18"	22¼"
Wall Thickness	1/16"	1/16"	3/32"	1/8"
Price Each	$7.50	$16.50	$21.75	$24.00

Cover Sizes and Prices

Stock No.	5-PTC	15-PTC	30-PTC	55-PTC
Size (gals)	5	15	30	55
Price Each	$3.50	$4.00	$4.50	$6.00

POLYETHYLENE PAILS LIGHTWEIGHT • LONG-LASTING

PASTEL COLORS . . . MOLDED IN ONE PIECE . . . GALVANIZED METAL BAIL.

Pail Sizes and Prices

Stock No.	11-PP	14-PP	17-PP
Capacity (qts.)	11	14	17
Height	10½"	11"	11½"
Diameter	10"	11"	12"
Price Each	$3.00	$3.50	$4.00

Covers Available for 11 qt. Pails ONLY
Cover Price 80c Ea.
Stock No. 11-PPC

PLACE YOUR ORDER TODAY!

PLATING PRODUCTS, Inc.
1509 N. WASHINGTON
KOKOMO, INDIANA

Corp., following completion on July 19 of a merger with Rad, Inc., a Cincinnati research and development firm.

Alfred F. Duemler, Jr., vice-president and treasurer, was associated with Rad, Inc. as vice-president following three years as plant manager of the Louisville Brass Plant of American Radiator and Standard Sanitary Corp.

Carl F. Holland, general sales manager, was previously sales manager of the Honan-Crane and Delpark product lines of the company.

E. John Van Lier, chief product engineer, was formerly engineering supervisor of technical sales for Purolator Products, Inc., development engineer with Komline & Sanderson Engineering, and project engineer with American Cyanamid Co.

Fred C. Valentin, chief manufacturing engineer, was manager of manufacturing engineering at Purolator Products, Inc. and was previously with Worcester Pressed Steel and Greer Hydraulics.

Charles T. Rose, appointed chief industrial engineer, was formerly plant manager with Walker Mfg. Co., Racine Wis.

Exchange of Technical Information Arranged

Eugen G. Leuze, publisher of the German technical journal *Galvanotechnik* and one of those active in the re-

Eugen G. Leuze

cent formation of the *Deutsche Gesellshaft fur Galvanotechnik*, and *Palmer H. Langdon*, publisher of METAL FINISHING, met in Stuttgart on April 25th with American Army sergeant Nachreimer from Pittsburgh as an interpreter to discuss arrangements for an exchange of technical articles and translations of books. Mr. Leuze's

81.73% RENEWALS

Media men agree that one of the best indications of the real value of a business publication to its subscribers is the rate of renewal. During the period of January 1959 to December 1960, renewals to METAL FINISHING increased from 73.91% to 81.73% — one of the highest renewal percentages among business papers — and without benefit of a special reduced price. This is the tremendous and unparalleled success story of METAL FINISHING — the industry's recognized engineering authority since 1903!

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monthly publication was established in 1902 at Leipzig and, except for a few years during World II, has been published continuously, moving to Saulgau in West Germany following the war. He is also the publisher of various books on plating, polishing, waste disposal and related finishing subjects, many of which have been translated into English.

Chainveyor Establishes Manufacturing Outlet

Chainveyor Corp., manufacturer of engineered overhead conveyor systems, has announced that *T. & T. Works, Ltd.*, Billesdon, Leicester, England, has been established as exclusive manufacturing and engineering outlet for the entire United Kingdom.

T. & T. Works will engineer, manufacture and install the complete line of overhead conveyor components on a royalty basis.

Sowers Appointed by Michigan Abrasive

J. C. (Jerry) Sowers has been appointed product engineer of *Michigan Abrasive Co.* His new responsibilities include field testing of products and

J. C. Sowers

new applications, qualifying of products on major accounts, review and recommendations on product testing, and liaison with abrasive equipment manufacturers.

Sowers has been one of the company's sales representatives for the past several years. Before that he was with Carborundum Co. for more than 10 years, and was employed in Cincinnati at Westinghouse before that. He served for 5½ years with the U. S. Air Force during World War II.

New Facilities for Almgard Metal Finishers

New facilities of *Almgard Metal Finishers, Inc.*, at Marietta, Ohio, designed to provide custom metal finishes for industries of the Mid-Ohio Valley and adjacent areas are now in full production, company spokesmen have announced. The facilities will permit the company to produce both anodized and textured surface treatments for aluminum and high quality painted finishes for other metals.

Finishes available include bright or buffed, satin, sandblasted, wire brushed, or caustic etched. A wide variety of effects, as final surface or as pretreatment prior to the protective anodize coating, are also available.

In addition to aluminum finishes, the facility will also specialize in the application of high quality painted finishes for other metals. New flow coating equipment permits chemical cleaning, phosphating, prime coating, and baking in a continuous operation.

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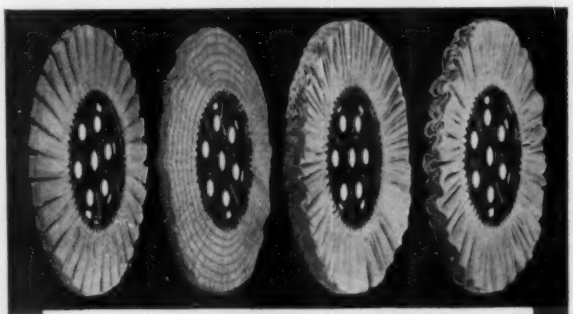

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Manufacturers' Literature

Industrial Compressors

Le Roi Div., Westinghouse Air Brake Co., Dept. MF, Sidney, Ohio.

Unit type compressors from ½ to 15 h.p., for displacements up to 70 c.f.m., are described together with stationary models from 25 to 100 horsepower for industrial air supply.

High Intensity Infrared Equipment

Fostoria Corp., Dept. 102, Dept. MF, 1200 N. Main St., Fostoria, Ohio.

A new brochure describes new techniques, using fluid cooling, now making possible very compact quartz lamp ovens and furnaces with extremely high heat transfer rates.

Metal Surfaces Courses

Milton Weiner, Room 217, Dept. MF, 12631 E. Imperial Highway, Santa Fe Springs, Calif.

A brochure is available on three consulting and training programs for metal finishing, all of which will run for twelve weeks. Courses start on September 18, 1961, January 8, 1962 and April 2, 1962, respectively.

Vacuum Pumps, Gas Boosters, Air Motors

Leiman Bros., Dept. MF, 102 Christie St., Newark 5, N. J.

New 32-page Catalog 561 gives complete data on rotary positive air pressure and high vacuum pumps, gas boosters and air motors. Included are details of construction, dimensions, capacities, performance curves, plus helpful engineering and installation data.

Rust Control During Production

Magnus Chemical Co., Inc., Dept. MF, South Ave., Garwood, N. J.

A concise, 8-page guide to controlling rust during production operations, has been incorporated into a Rust Control Data File. The guide details the known and little-known causes of rust, the six factors vital to successful rust control, the many specialized rust prevention products which are available and methods of selecting the proper rust preventive for specific operations and degrees of control.

Cleaning-Phosphating

Oakite Products, Inc., Dept. MF, 118 Rector St., New York 6, N. Y.

A new, highly informative, 4-page booklet outlines the merits of CrysCoat 187, an iron phosphating material especially designed for simultaneous cleaning and phosphating by tank application.

The booklet contains a technical product description, a brief method outline for applying the material and an insight into the simplicity of solution control which it affords.

Process Equipment

The Pfaudler Co., Dept. MF, 1131 West Ave., Rochester, N. Y.

This 16-page buyer's guide, Bulletin 1010 is divided into two primary sections, and includes items of process equipment fabricated from Glasteel, Nucerite, stainless steel, titanium, zirconium, tantalum and other materials for corrosion resistant services such as

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reactions, distillation and evaporation, drying and blending, centrifuging, heat transfer, filling, storage, agitation, valving and piping. Also described are equipment for water treatment, ion exchange, gas analysis, aeration, flow rate metering and control, demineralization and waste treatment.

Fume Disposal

Industrial Plastics Fabricators, Inc., Dept. MF, Endicott St., Norwood, Mass.

New 36-page Catalog "F" includes complete details on the company's complete line of unplasticized Type I, PVC centrifugal, tubeaxial, and utility fans, and air washers. Photographs, dimension diagrams, performance tables, and description of each item are listed separately.

Design and applications of complete exhaust systems are illustrated. Complete chemical-resistance data are tabulated for normal and high-impact PVC and various metals, covering all types of chemicals and their resistance ratings. Some PVC mill supplies and special products are shown and described.

Immersion Gold Solution

Engelhard Industries, Inc., Chemical Div., Dept. MF, 113 Astor St., Newark 2, N. J.

A four-page data folder is available on Atomex, an immersion gold solution. Information is given on the metals that may be coated with the process, preparation of the work, operating conditions, control and major advantages.

Filtration Equipment

Industrial Filter & Pump Mfg. Co., Dept. MF, 5900 Ogden Ave., Cicero 50, Ill.

Four new bulletins give full details on various types of filters designed and manufactured for industrial processing requirements. Each of the bulletins carries the number of the particular line of filters it describes.

Bulletin 112 covers the firm's Type 112 vertical pressure filter. This type features three styles for both wet and dry cake discharge, and is easy to service.

Bulletin 114 describes the "Hydra-Shoc" Type 114 filter, an exclusive design that employs back-flow pressure to facilitate its operation.

Bulletin 122 tells of the Type 122 horizontal pressure filter, a versatile series with interchangeable and individually removable filter leaves.

Bulletin 123 describes the Type 123 tubular filter, applicable for usage with liquids in the chemical, food and plating process industries.

Measuring Stress

Joseph B. Kushner Electroplating School, Dept. MF, 621 S. Norman Ave., Evansville 14, Ind.

The Stresometer, an instrument used for measuring stress in electrodeposited metals, is the subject of a four-page, illustrated brochure. Information is given on the principle of the instrument, accuracy, results obtained and its advantages.

Chromate Conversion Coating

MacDermid Inc., Dept. MF, Waterbury 20, Conn.

Macro Brite L-10B, a new chromate conversion coating for zinc or cadmium which eliminates the handling of

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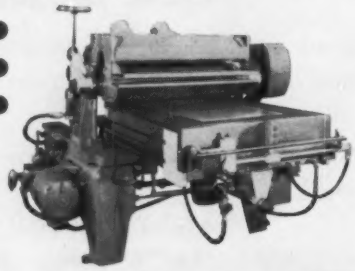

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Electro-Glo

liquid acid in chromating is fully described in Technical Data Sheet No. 129, a three-page usage and instruction sheet.

Spray Cleaner Selection

J. B. Ford Div., Wyandotte Chemicals Corp., Dept. MF, Wyandotte, Mich.

A 6-page folder, F-2889, covers one-operation cleaning and phosphating, simultaneous cleaning and rust-proofing, heavy-duty cleaning without foaming, and aluminum cleaning without etching.

Simplified layout and brief copy make the folder readable and easy to follow.

Anodes and Plating Chemicals

Hanson-Van Winkle-Munning Co., Dept. MF, Church St., Matawan, N. J.

A two-color, eight page bulletin, No. AC-113, illustrates and describes a full line of anodes, anode accessories, and chemicals for electroplating and metal-finishing.

Nickel, cadmium, brass and bronze, copper, lead and zinc anodes are described and illustrated. Various types of nickel anodes are listed along with recommended applications and pH ranges. One full page of drawings gives instructions on how to order hooks for round, flat and shaped lead anodes.

Descriptions and recommended applications are given for several styles of anode bags. Instructions on how to order regular anode hooks are also given.

Respirators

Mine Safety Appliances Co., Dept. MF, 201 N. Braddock Ave., Pittsburgh 8, Pa.

Four-page illustrated folder, No. 1007-10, shows how one facepiece can be used with a variety of filters and chemical cartridges to protect against dust concentrations, metal fumes, organic vapors, acid gases, ammonia, and other airborne hazards. A guide to the selection of the correct filter for protection against different types of dust and fumes is given on the back cover of the bulletin.

Spray Booth Coating

Spraylat Corp., Dept. MF, 1 Park Ave., New York 16, N. Y.

A booklet is available on Booth-Strip, a water-base, plastic, strippable coating, which describes an actual plant evaluation and explains the reasons for the saving in booth maintenance cost.

Automatic Sheet Polishing Machine

Yates-American Machine Co., Dept. MF, Beloit, Wisc.

New 4-page bulletin illustrates and describes the new Model S-101 automatic polishing machine especially designed to produce superior, precision-controlled finishes on sheet type materials.

Pressure-Sensitive Tapes

Mystik Adhesive Products, Inc., Dept. MF, 2635 No. Kildare Ave., Chicago 39, Ill.

A new 44-page guide to pressure-sensitive tapes gives handy reference data on a full line of paper masking tapes, packaging tapes, protective cov-

STUTZ BALL ANODE CONTAINER

New Construction for longer Service . . .

STUTZ CONSTRUCTION

Heavy gauge steel with wire woven through steel angle firmly attached to main stem. Cannot come apart or loosen. Side clip is for STUTZ BARREL PLATING TANKS having submerged rectangular anode bars. Side clip not furnished for racked plating tanks unless specified. Standard hook 6 inches. Other hook lengths available, however deliveries could be delayed.

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Note how welds have dissolved or broken in use. Often caused in barrel plating where currents are high and barrel transfer is rapid.

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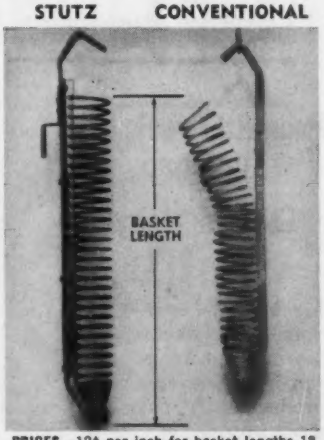

PRICES—12¢ per inch for basket lengths 18 inches or longer in increments of 3 inches. Side clips 25¢ extra. Shorter containers available at 18" price. Curved containers one size only, 27" for 14" and 16" diameter barrels 15¢ per basket additional.

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erings, high-low temperature tapes, electrical tapes, printable tapes, and specialties. Typical applications are suggested, and the guide is pocket-sized for convenience. A quick reference index speeds up the selection of tapes.

Temperature Regulator

OPW-Jordan Corp., Dept. MF, 6013 Wiehe Road, Cincinnati 13, Ohio.

A new 8-page temperature regulator catalog, TCV-1, is fully illustrated and contains complete engineering information and technical data. The catalog shows cutaway pictures, features, names of parts, ratings, dimensions, applications, operation, ranges, materials of construction, sample specifications, flow curve and sizing charts. Prices are also sent with the catalog.

Cleaning Steel Before Electroplating

Oakite Products, Inc., Dept. MF, 118 Rector St., New York 6, N. Y.

A new, 8-page, illustrated booklet details the latest methods of cleaning steel before electroplating. It features detailed outlines of specific procedures (names materials, concentrations, temperatures and treatment times) and colorful diagrams illustrating the mechanics of both direct current and reverse current electrocleaning.

Also pinpointed are recommended materials used for reverse current cleaning which provide the important advantages of high conductivity, superior smut removal, controlled foaming, sufficient water-softening and long solution life.

Polyvinyl Chloride Products

Kaykor Products Corp., Dept. MF, Yardville, N. J.

Catalog RV-61 covers basic material data on rigid PVC products used in the fabrication of a wide variety of products, also information on fabrication procedures and case histories of applications.

Thickness Tester

Twin City Testing Corp., Dept. MF, 533 So. Niagara St., Tonawanda, N. Y.

A new brochure introduces the Type EC Permascope for non-destructive measurement of (1) a non-conductive coating on a non-ferrous basis metal such as aluminum or copper, (2) a non-ferrous coating on a non-ferrous base, (3) a non-ferrous coating on a non-conductor, and (4) conductivity of a non-ferrous metal.

As well as containing descriptive information, specifications and prices for the new instrument, the brochure includes details on Type ES Permascopes for gaging coatings on iron and steel plus a technical discussion of non-destructive thickness testing.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Detroit Branch

Brief thunder showers on July 22nd, at Glen Oaks Country Club, Farmington, Mich., did not dampen the festive mood of over 800 members and guests attending the annual Branch Stag Day. National A.E.S. President, *Chester Borlett*, and 1st Vice-President, *Man-*

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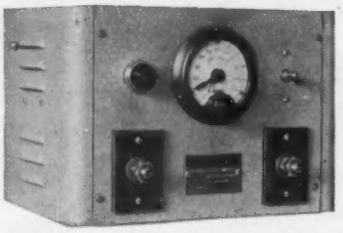

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uel Ben, were present, as well as many friends from neighboring Branches. There was also a fine showing of past-presidents, including *Ralph Wysong*, *Herberth Head*, *Cleve Nixon* and *Walter Pinner*.

General Chairman *Louis J. Camill*, with the fine cooperation of the Stag Day Committee, had a full, well-organized day planned. There was plenty of activity and entertainment for everyone's tastes and moods. The outstanding door prizes included a portable television set, camera, typewriter and golf clubs.

William Devan

Buffalo Branch

The Branch will hold its first meeting of the 1961-1962 season, Friday Sept. 15, at the Red Lobster Restaurant Buffalo, N. Y.

The executive board of the A.E.S. will be present at this meeting. *Al Korbelak*, vice-president of marketing and new product development of Sel-Rex Corp., will be the speaker of the evening. Mr. Korbelak has chosen for his topic, "Precious Metal Plating and Their Solderability."

Plans for the new season and reports on the National Convention held in Boston, Mass., will be covered in the business session and will be of utmost importance to all Buffalo Branch members.

The October meeting will be held in Jamestown, N. Y. on Friday, October 13. The speaker and place of meeting will be announced later.

Robert C. Eich,
Secretary

Midwest Regional Council

Argonne National Laboratories, Lemont, Ill., will be the host for the Third Annual Technical and Workshop Session of the Midwest Regional Council on Saturday, October 28.

A symposium, "Plating On Uncommon Basis Metals" will be the highlight of the meeting to be held in conjunction with the traditional workshops on metal finishing problems. Papers dealing with plating on chromium, titanium, uranium, tungsten, and precious metals will be included in the program.

Workshops on practical finishing operations will be held in various rooms at the laboratory. These workshops and their respective chairmen are: Organics, *Tom McCullough*, National Lock Co.; Cleaning, *S. P. Gary*, Scientific Control Laboratories; Pickling, *Russ Harr*, Western Electric Co.; Barrel Plating, *E. P. McCoy*, Electrochemical Products Co.

Registration for the program will be limited to the available seating capacity. Branches will be advised of their quotas ahead of time, which can be filled on a first come, first served basis.

A steak dinner and guided tour of the atomic reactors at this government site will be included in the $9.00 registration fee.

For full information write *Alexander Alexander*, 122 Twelfth St., Rockford, Ill.

AMERICAN SOCIETY FOR METALS

The Metal Show, to take place on October 23-27 in Detroit's new Cobo Hall, will have over 275 exhibitors, one of the greatest concentrations of materials and processing companies in

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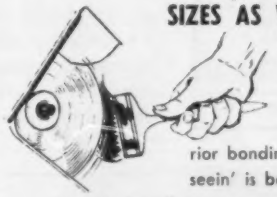

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the 43-year history of the show. A record number of ten technical societies and trade associations will participate in the technical program, and sessions will run concurrently with presentation of exhibits, most of them in meeting rooms adjacent to the exhibits.

Among the papers of interest to finishers which will be presented are: "Corrosion in Action" (film), International Nickel Co.; "Galvanized Steel for Automotive Use," *J. C. Widman*, Ford Motor Co.; "Paint Systems for Corrosion Protection," *Norman Price* and *C. O. Durbin*, Chrysler Corp.; "Chemical Milling," *George H. Fox, Jr.*, Chem-Mill Div., Turco Products; "Electrolytic Metal Removal Process-

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es," *Lynn A. William*, Anocut Engineering Co.; and "Fusion Bond — a New Method for Combining Plastic and Metal," *W. R. Pascoe*, The Polymer Corp.

A.S.T.M.

Encouraged by the marked success achieved in 1956 when ASTM Committee B-8 sponsored a Symposium on Electroplated Coatings, this same committee now plans a Symposium on Electroforming. The event, which will schedule 12 papers to be presented at three sessions, will occur during ASTM Committee Week in Dallas, Texas, in early February, 1962.

With *A. D. Squitero* acting as co-chairman, the Symposium is being organized by *W. L. Pinner*, who also arranged the one held in 1956. The program is in the advanced planning stage and will include papers on electroforming solutions, properties of electroformed deposits and the practical application of electroforming in the manufacture of essential products used in diverse industries such as automotive, space vehicle and the recording field.

Details of the exact program will be published at a later date. It is expected that the meeting will attract considerable interest, especially among engineers producing or using the products of the electroforming industry.

N.A.M.F.

Edward N. Marlette, president of the *National Association of Metal Finishers*, sole management organization of the plating and finishing industry, has named 13 industry leaders to top committee posts. The appointments, of one year's duration, are effective at once. Individual committee members will be appointed in the next few weeks.

The new chairmen: educational — *W. R. Crawford*, Chrome-Rite Corp., Chicago; membership, constitution and by-laws — *James E. Cogan, Jr.*, Globe Electroplating Co., Philadelphia; public relations — *Harold E. Coombes, Jr.*, Crown City Plating Co., El Monte, Calif.; government liaison — *Jerry Burton*, Burton Silverplating Co., Culver City, Calif.; standards — *Henry A. Kafarski*, Chemical Processing, Inc., Detroit; labor relations — *Glenn H. Friedt, Jr.*, United Platers, Inc., Detroit; ethical practices — *John T. Hyduke*, Durable Plating Co., Cleveland; trade tour — *Jules Horelick*, Allied Metal Finishing, Baltimore; liaison, American Electroplaters' Society — *A. T. Leonard*, Superior Plating, Inc., Minneapolis; liaison, Metal Finishing Suppliers' Association — *Robert L. Giesel*, Adolph Plating, Inc., Chicago; budget and finance — *A. T. Leonard, Jules Horelick; Frank Kaiser*, Long Island Mechanical Plating Co., Woodside, N. Y.; *Sal Novelli*, Service Plating Co., Brooklyn; and *Mariano Ranno*, Imperial Plating, Inc., Brooklyn; and industry liaison — *Charles R. Leva, Levco* Metal Finishers, Inc., Long Island, N. Y.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

Paints and coatings for industrial exposures will be presented at five regional conferences of the N.A.C.E. this fall. Meetings will be held as follows: Western Region, Portland, Ore., Oct. 4-6, North Central Region, St. Louis, Oct. 9-11, South Central Region, Houston, Oct. 24-26, Northeast Region, Oct. 30-Nov. 2, Southeast Region meeting and short course Miami, Nov. 27-Dec. 1.

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NEWS FROM CALIFORNIA

Three plating firms situated in the San Fernando Valley area of Los Angeles recently undertook to sponsor the publishing of a "Process Value Engineering" information bulletin. Sponsors of the publication, which will be distributed monthly to manufacturer customers of plating firms, are Technical Metal Finishing Co., Inc., Glendale; Chemical Metals, Inc., Van Nuys; and Vineland Electronics Plating Co., Inc., North Hollywood.

The engineering bulletin will be dedicated to the dissemination of information on the importance of the process value factor in engineering. The bulletin will distribute information on the various ways in which processing time and money on an item to be plated can be saved by reevaluating the design or the finishing specifications.

The sponsors point out that many cases can be cited in which the manufacturer specified a certain deposit but changed his specifications when he was shown that another process or finish would give equally good results at less cost.

The sponsors of the bulletin contend that, frequently, a suggestion can be made to a manufacturer for a minor design change on a part to accommodate plating, which may result in a substantial saving. Since process value, in most cases, can be related directly to cost, the sponsors of the engineering bulletin believe that the plater, with the practical knowledge and understanding he has of the subject, is in a good position to help the manufacturer. The plater, they contend, should develop an awareness of the customer's design requirements and consult with him whenever it is obvious that a part or unit has poor processing value.

Milton Weiner, chemical engineer of Santa Fe Springs, Calif., and sponsor of the Weiner Electroplating School, has announced that arrangements for a Fall term in electroplating and metal finishing have been completed.

Classes will be held every Monday night from 7:15 to 9:45 o'clock beginning September 18 at the Weiner Laboratory in Santa Fe Springs.

The Northrop Corp. recently installed a new metal cleaning process system in its Norair Div. plant in Hawthorne, Calif., designed to speed the cleaning for several different solution sequences.

While the system is primarily intended for preparing stainless steel honeycomb and skins prior to assembly for brazing, it has been designed with sufficient versatility and flexibility to integrate the necessary facilities for cleaning copper heat-distribution plates and steel fixtures used in conjunction with the process, and without the hazard of solution contamination.

The installation consists of 14 alkaline and rinse tanks and a dry-off oven. Fume separators have been installed to draw off toxic vapors from the acid tanks. A compact arrangement of the preparation tanks (each 4 ft. wide, 10 ft. long, by 6 ft. deep) economizes on floor space and assures an efficient flow of work. This has been accomplished by setting up the preparation tanks on both sides of the working aisle and servicing them with an overhead, stabilized, shuttle-type crane.

While plastics and materials other than steel are making substantial inroads in the beer can market, once practically monopolized by tinplate, the California can making industry is reportedly fighting back with improved

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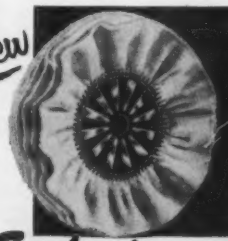

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methods of can production and finishing.

A recent report reveals that, in 1960, the California brewing industry bought 740 million metal containers at a cost of $25 million. Continental Can Co., which operates three plants in Los Angeles and other areas of California for production of metal beer cans, uses steel rolled to exact specifications by western tinplate producers, coated with a film of tin varying from 15 to 80 millionths inch thick on each side.

The coils of steel for beer cans are tinned by electrolysis. The tinplate used for the body of the can is given one application of enamel, the tnds of the containers three coats. After the application of the enamel, the sheets are conveyed into an oven that bakes the enamel at temperatures as high as 420°F. After the sheets have been formed into cans, the inside is given a spray coating of lacquer.

Dalton Davis, who served as a process engineer with Douglas Aircraft Co. in El Segundo, Calif., from 1948 to early in 1961, has been appointed sales manager of the Travis Plating Co., Los Angeles.

In order to provide technical advice and to accelerate service to West Coast patrons, *Sigmund Cohn Corp.* has recently organized the *Sigmund Cohn Corp. of California*, 151 C. North Maple St., Burbank, Calif. This West Coast organization will handle the various

Fred Karg

lines of wire, sheet and other products of the company and its affiliates, *Sigmund Cohn Mfg. Co., Inc.* and *Pyrofuze Corp.*

Fred Karg, a man of long experience in the field, is in charge of the California office. He received his technical training at the Newark College of Engineering and the University of Southern California. Prior to his present connection, Mr. Karg, for many years, was associated in an engineering capacity with one of the West Coast's well-known instrument manufacturers. He also has had technical machine shop experience; served for four years with the U. S. Navy Seabees.

The Diversey Corp. of Chicago, Ill., has named *R. L. Cawley* as its Southern Pacific division manager. In his new post Cawley has supervision over sales and promotion in the extreme southern area of California and in the state of Arizona.

Twelve past-presidents ranging from immediate past-president *Leonard S. Wilson* (1960-61) back to *Dean Morgan* (1927-28), were guests of honor at the June 14 meeting of the Los Angeles Society for Coatings Technology at the Montebello Country Club, Montebello, Calif.

In addition to Wilson and Morgan, former gavel wielders honored were *C. C. Howson* (1930-31), *Ted Hawlish* (1939-1940), *William Gerhardt* (1940-41), *H. D. George* (1942-43), *John B. Warner* (1945-46), *Frank Witteman* (1948-49), *Al Scotland* (1950-51), *Charles W. Finnegan* (1956-57), *Frank H. Martin* (1957-58), and *Ted Becket* (1958-59).

Incumbent president *Alan U. Hershey*, who was elected at the June 14 meeting, presided. Other new officers chosen that night are vice president, *Charles Mooney;* treasurer, *Walker K. Barber;* and secretary, *Albert M. Aronow*.

Speaker of the evening was *Donald F. Koenecke*, manager of technical services, Buton Resins, Enjay Corp. He discussed the use of petrochemical polymers in protective coatings.

The Society's 14th annual supper party and dance was held at the Huntington-Sheraton Hotel in Pasadena on the night of August 5.

A training program for apprentice platers, launched in February by a group of finishing shop owners in Los Angeles' San Fernando Valley, has met with such success that, in mid-July, 39 student platers had been signed up for the weekly night-school classes at the Van Nuys High School.

Class instruction is directed by *Meyer Roter*, a plating technician for Radiophone, Inc. Students are required to complete a scheduled 6,000 hours of training under the guidance and approval of the California Apprenticeship Council. The schedule includes speci-

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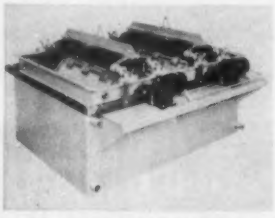

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fied numbers of hours of on-the-job training in accredited plating shops.

Seven plating shop owners who compose the "Plating Industry Council," now meet once a month in the Van Nuys Chamber of Commerce to screen applicants and exercise direction over the program in collaboration with a representative of the California Apprenticeship Council.

NEW BOOKS

Introduction to Electroplating

By Ezra A. Blount. Published by American Electroplaters' Society, Inc., 443 Broad St., Newark 2, N. J. 1961. 18 pages. Price: 35 cents.

This little booklet describes the process of electroplating in outline, for those completely unfamiliar with the field. The metals commonly plated, their properties and applications are tabulated. About half of the material in this introduction covers equipment. Although the subject matter is handled adequately, in accordance with the title, future revisions might benefit by elimination of photos which are meaningless to the uninitiated, and substitution of auxiliary processes such as polishing and anodizing.

RARE METALS HANDBOOK

Edited by Clifford A. Hampel. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 1961. 715 pages, including index. Price: $20.00.

In this second edition are presented data by 44 authorities on 55 of the less common metals. The material has been expanded to cover the latest information on production, chemical and physical properties, fabrication techniques, and applications. A complete list of references will be found at the end of each chapter. Since a book could probably be written on each of the metals covered, the chapters could be considered surveys of the subjects. However, the most important data are included, and the references cited will answer the needs of those readers who need to delve further. The volume is arranged in a handy format which facilitates access to all material.

METAL INDUSTRY HANDBOOK & DIRECTORY

Published by Iliffe Books Ltd., Dorset House, Stamford St., London, S.E. 1, England. 1961. 562 pages. Price: 21s.

The 50th edition of this annual handbook-directory continues to follow the format of previous editions, with four sections: general properties of metals and alloys, general data and tables, electroplating and allied processes, and a directory section. Since the book is published in the interest of those engaged in the non-ferrous metal industries, the section on finishing is quite adequate for the readership, although not at all extensive. Anyone interested in British specifications for metals and finishes, will find the book valuable. The very complete directory of suppliers, as usual, is one of the best features, although of interest to British rather than to foreign readers.

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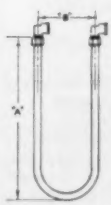

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Oct. 1-5: Fall Meeting, The Electrochemical Society, Hotel Statler, Detroit, Mich.

Oct. 16-19: 2nd International Congress on Vacuum Technology, Sheraton Park Hotel, Washington, D. C.

Oct. 23-27: 43rd National Metal Show and Congress, American Society for Metals, Cobo Hall, Detroit, Mich.

Oct. 28: 3rd Annual Technical and Workshop Sessions, Midwest Regional Council, Argonne National Laboratories, Lemont, Ill.

Nov. 2-4: 39th Annual Meeting, Federation of Societies for Paint Technology, Washington, D. C.

Dec. 1-2: Annual Educational Meeting and Banquet, Detroit Branch A.E.S., Statler-Hilton Hotel, Detroit, Mich.

Dec. 15-16: Annual Educational Session and Banquet, Newark Branch AES, Robert Treat Hotel, Newark, N. J.

Jan. 20: Annual Meeting, Grand Rapids Branch AES, Pantlind Hotel, Grand Rapids, Mich.

Jan. 27: Annual Educational Meeting and Banquet, Chicago Branch AES, Conrad Hilton Hotel, Chicago, Ill.

Jan. 30-Feb. 2: 18th Annual Technical Conference, Society of Plastics Engineers, Penn-Sheraton Hotel, Pittsburgh, Pa.

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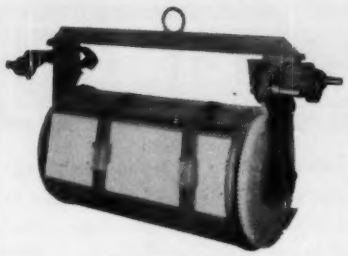

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845	47.3	Elec. Prod.
940	32	Elec. Prod.
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1500	30/50	Century
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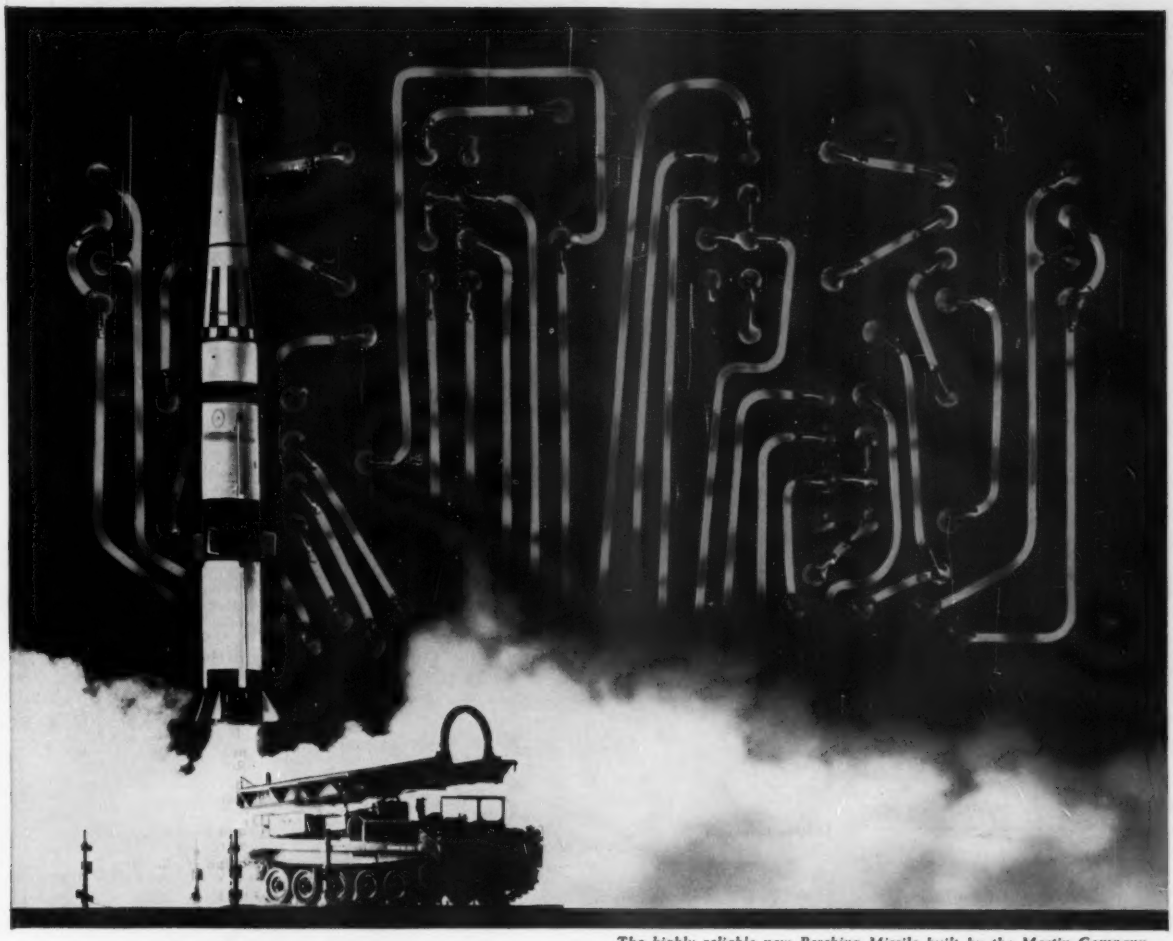

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